CHICOPEE RIVER WATERSHED

BARRE FALLS DAM

CONANT BROOK DAM

MASSACHUSETTS

CONNECTICUT RIVER BASIN

MASTER MANUAL OF WATER CONTROL

APPENDIX G

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JANUARY 1979

TC423
.N43C752 Connecticut River Basin master manual
1983 of water control, New Hampshire,
Vermont, Massachusetts, Connecticut.
-- Waltham, Mass. : U.S. Army Corps
v.1 of Engineers, New England Division,
1983-
App.A 10 v. : ill., maps ; 30 cm.
1971 Previous title: Master manual of
App.B reservoir regulation.
1985 Cover title: Connecticut River Basin
master water control manual.
App.C Contents: v.1. Master manual --
1968 App.A. Ompompanoosuc River watershed,
Vermont -- App.B. Ottauquechee River
App.D watershed, Vermont -- App.C. Black
1973 River watershed, Vermont -- App.D. West
River watersh ed, Vermont -- App.E.
App 6 Ashuelot Rive r watershed, New
1979 Hampshire and Massachusetts --
29 AUG 86 14163055 AEEMsl SEE NEXT CRD

TC423
.N43C752 Connecticut River Basin master manual
1983 of water control, New Hampshire,
Vermont, Massachusetts, Connecticut.
... 1983- (Card 2)
App.F. Millers River watershed, New
Hampshire and Massachusetts -- App.G.
Chicopee River watershed, Massachusetts
-- App.H. Westfield River watershed,
Massachusetts and Connecticut -- App.J.
Farmington River watershed, Connecticut
and Massachusetts.

29 AUG 86 14163055 AEEMsl SEE NEXT CRD

TC423
.N43C752 Connecticut River Basin master manual
1983 of water control, New Hampshire,
Vermont, Massachusetts, Connecticut.
... 1983- (Card 3)
1. Reservoirs--Connecticut River
watershed. 2. Flood control--
Connecticut River watershed. 3. Flood
dams and reservoirs--Connecticut River
watershed. 4. Connecticut River
watershed--Reservoirs. I. United
States. Army. Corps of Engineers. New
England Division. II. Title: Master
manual of water control. III. Title:
Connecticut River Basin master water
control manual. IV. Title: Master
manual of reservoir regulation.

29 AUG 86 14163055 AEEMsl

CONNECTICUT RIVER BASIN
MASTER MANUAL
WATER CONTROL

APPENDIX G

CHICOPEE RIVER WATERSHED
BARRE FALLS DAM
CONANT BROOK DAM
MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

JUNE 1964
REVISED JANUARY 1979

PREFACE

The Chicopee River watershed has a drainage area of 721 square miles and is located in central Massachusetts. The flood control system for the watershed described in this manual consists of Barre Falls Dam in Barre, Conant Brook Dam in Monson and five local protection projects. The five local protection projects are located in Ware, West Warren, Palmer (Three Rivers), Chicopee Falls and Chicopee.

This Appendix of the Connecticut River Master Manual of Water Control includes a description of the watershed, hydrologic, climatological and flood data, together with project descriptions and regulation procedures for Corps reservoirs. In addition to setting forth a method of water control, the manual will serve as a reference source for future studies.

The manual is divided into seven chapters: Introduction, Management, Hydrometeorology, Communications, Hydrologic Forecasts, Reservoir Regulation and Hydrologic Equipment. The setup of chapters allows the reader to obtain desired general background information on any particular aspect of each project.

Pertinent data on the hydrologic information of the Chicopee River watershed, Barre Falls Dam and Conant Brook Dam are shown on pages i, ii, iii, respectively, at the front of the manual.

The chapter on reservoir regulation contains detailed procedures and information necessary for regulating the protective works to provide protection for downstream communities on the Ware, Chicopee and Connecticut Rivers.

CONNECTICUT RIVER BASIN

MASTER MANUAL
OF
WATER CONTROL

Appendix	Watershed	Reservoir	Status
Master Manual	Connecticut River		Started
A	Ompompanoosuc R.	Union Village	Completed 1950 (Revised 1971)
B	Ottauquechee River	North Hartland	Completed 1969
C	Black River	North Springfield	Completed 1968
D	West River	Ball Mountain Townshend	Completed 1965 (Revised 1973)
E	Ashuelot River	Surry Mountain Otter Brook	Completed 1962 (Revised 1972)
F	Millers River	Birch Hill Tully	Completed 1950 (Revised 1974)
G	Chicopee River	Barre Falls Conant Brook	Completed 1964 (Revised 1979)
H	Westfield River	Knightville Littleville	Completed 1967 (Revised 1978)
I	Farmington River	Colebrook River Mad River Sucker Brook	Completed 1970

MANUAL OF WATER CONTROL
CHICOPEE RIVER WATERSHED
MASSACHUSETTS

APPENDIX G

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August 1978

PERTINENT DATA
CHICOPEE RIVER WATERSHED
HYDROLOGIC INFORMATION

DRAINAGE AREA

Mainstem - Chicopee River	Square Miles
Chicopee River at Three Rivers	688
Broad Brook at mouth	15
Twelve Mile Brook at mouth	14
Chicopee River at Indian Orchard	703
Fuller Brook at mouth	14
Chicopee River at mouth	721
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Swift River at mouth	216
Jabish Brook at mouth	19
Ware River at mouth of the Swift River	216
Ware River at the mouth	435
Quaboag River	
Sevenmile River at mouth	41
Fivemile River at mouth	24
Quaboag River at West Brookfield	96
Quaboag River at West Warren (W. Warren Ind. Co.)	143
Mill Brook at mouth	14
Chicopee Brook at mouth	16
Conant Brook at mouth	9
Quaboag River at mouth of Chicopee Brook	180
Quaboag River at Palmer	203
Quaboag River at mouth	210

Precipitation	Barre Falls Dam Massachusetts (Inches)	Chicopee River @ Ware, Massachusetts (Inches)	Westover Field Massachusetts (Inches)
Mean Annual	39.4	44.7	44.9
Maximum Annual	53.6 (1975)	60.0 (1955)	53.4 (1955)
Minimum Annual	26.2 (1965)	26.4 (1965)	34.3 (1957)
Years of Record (through 1976)	18	49	22 (Discontinued after 1963)

WATER EQUIVALENT IN SNOW COVER
(Based on Corps of Engineers Surveys 1958-1978)

	Mean (inches)	Maximum (inches)	Minimum (inches)
1 February	2.2	4.6	0.0
15 February	2.9	6.2	0.0
1 March	3.1	6.4	0.0
15 March	2.7	6.1	0.0
1 April	1.2	4.1	0.0
15 Arpil	0.1	0.7	0.0

USGS GAGES	Drainage Area (sq. mi.)	Tributary	Period of Record
Ware River near Barre	55.0	Ware	1946 - Present
Ware River at Coldbrook	96.8	Ware	1928 - Present
Ware River at Gibbs Crossing	199.9	Ware	1912 - Present
Hop Brook near New Salem	3.4	Swift	1947 - Present
E. Branch Swift River near Hardwick	43.7	Swift	1937 - Present
Swift River at West Ware	188.0	Swift	1910 - Present
Sevenmile River near Spencer	8.6	Quaboag	1960 - Present
Quaboag River at West Brimfield	151.0	Quaboag	1909 - Present
Chicopee River at Indian Orchard	688.0	Chicopee	1939 - Present
Chicopee River at Bircham Bend	703.0	Chicopee	1928 - 1938

PEAK FLOWS

Chicopee River at Indian Orchard, Mass.

Date	CFS	CSM
21 Sep 1938	45,200	66
19 Aug 1955	40,500	59
19 Mar 1936	20,400	30

Swift River at Ware, Mass.

Date	CFS	CSM
19 Mar 1936	7,590	40
22 Sep 1938	5,540	29

Quaboag River at W. Brimfield, Mass.

Date	CFS	CSM
19 Aug 1955	12,800	85
21 Sep 1938	8,470	56
19 Mar 1936	3,620	24

Ware River at Gibbs Crossing, Mass.

Date	CFS	CSM
21 Sep 1938	22,700	114
19 Aug 1955	12,200	61
19 Mar 1936	11,200	56

ANNUAL RUNOFF*

Chicopee River nr Indian Orchard, Mass.

	CFS	Inches	Year
Mean	901	18	(50 yrs)
Maximum	1952	39	1966
Minimum	376	7.5	1938

Quaboag River nr W. Brimfield, Mass.

	CFS	Inches	Year
Mean	241	22	(65 yrs)
Maximum	430	39	1938
Minimum	104	9.4	1930, 65

Swift River nr Ware, Mass.

	CFS	Inches	Year
Mean	188	14	(65 yrs)
Maximum	497	36	1938
Minimum	31	2.3	1945

Ware River nr Gibbs Crossing

	CFS	Inches	Year
Mean	288	20	(66 yrs)
Maximum	581	40	1938
Minimum	105	7.2	1965

*Through Water Year 1977

FLOOD ROUTING COEFFICIENTS

Reach	Routing Coefficient	River Miles Between Points
Barre Falls to Coldbrook	3/1 - 3 hr.	4.2
Coldbrook to Barre Plains	3/1	3.3
Barre Plains to Gibbs Crossing	5/3	17.2
Gibbs Crossing to Three Rivers	3/1	8.8
Conant Brook to Three Rivers	4/1	28.0
Three Rivers to Indian Orchard	3/1	10.8
Indian Orchard to Mouth of Chicopee	3/1	7.2

HIGH FLOW TRAVEL TIMES

	Total Hours From Barre Falls Dam
Coldbrook	3-4
Barre Plains	5-7
Gibbs Crossing	15-16
Three Rivers	18-20
Indian Orchard	21
Mouth of Chicopee	22-26

PERTINENT DATA
BARRE FALLS DAM

June 1978

LOCATION — Ware River; Barre, Massachusetts

DRAINAGE AREA — 55 Square Miles

STORAGE USES — Flood Control

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (ft)	Area (acres)	Capacity Acre-Feet	Capacity Inches on Drainage Area
Inlet Elevation	761	0	0	0	0
Spillway Crest	807	46	1,400	24,000	8.2
Maximum Surcharge	825	64	2,950	63,000	21.5
Top of Dam	830	69	-	-	-

EMBANKMENT FEATURES

	Main Dam - Rolled earth fill with rock protection	Dikes
Type		3
Length (feet)	885	3,215 (total)
Top Width (feet)	25	15
Top Elev. (ft msl)	830	830
Max. Height (ft)	69	48

SPILLWAY

Location	Right abutment of the dam
Type	Uncontrolled ogee weir, chute spillway in rock
Crest Length (feet)	60
Crest Elev. (ft msl)	807
Max. Surcharge (ft)	18.0
Maximum Discharge Capacity (cfs)	16,300

SPILLWAY DESIGN FLOOD

	Original Design	1973 Studies
Peak Inflow (cfs)	68,300	61,000
Peak Outflow (cfs)	16,300 (spillway only)	14,800
Volume Runoff (Ac. Ft.)	62,500	55,500

OUTLET WORKS

Type	Horseshoe conduit
Tunnel Inside	9'8" diameter
Tunnel Length (ft)	250
Service Gate Type	Electrically operated gear driven sluice
Size	Two 4.5' wide x 9.0' high
Emergency Gate Type	None
Downstream Channel Capacity (cfs)	1,000
Discharge Cap. at Spillway Crest (cfs)	3,000

LAND ACQUISITION

Guide Taking Line	815 ft msl (both fee and easement)
Fee (acres)	557
Easement (acres)	1,869

MAXIMUM POOL OF RECORD

Date	April 1960
Stage (feet)	36.5
Elevation (ft msl)	797.9
Percent Full	50

UNIT RUNOFF

One Inch Runoff (Ac. Ft.)	2,935

OPERATING TIME

Open/close all gates	1 foot/min

PROJECT COST (THROUGH FY 1977) — $1,968,000

DATE OF COMPLETION — July 1958

MAINTAINED BY — New England Division, Corps of Engineers

PERTINENT DATA
CONANT BROOK DAM

July 1978

LOCATION — Conant Brook; Monson, Massachusetts

DRAINAGE AREA — 7.8 Square Miles

STORAGE USES — Flood Control

RESERVOIR STORAGE

	Elevation (ft, msl)	Stage (ft)	Area (acres)	Capacity: Acre-Feet	Capacity: Inches on Drainage Area
Invert	694	0	0	0	0
Spillway Crest	757	63	158	3,740	9.0
Maximum Surcharge	766	72	216	5,400	13.0
Top of Dam	771	77	-	-	-

EMBANKMENT FEATURES

Type	Earth w/rockfill slope protection
Length	1,050
Top Width (feet)	20
Top Elevation (ft msl)	771
Maximum Height (feet)	85
Volume (cubic yards)	340,000
Dike	One - 5,600 feet northeast of Dam; 980 feet long by 14 feet high

SPILLWAY

Location	Right abutment
Type	Ogee weir, chute spillway
Crest Length	100 feet
Crest Elevation	757 feet msl
Surcharge Elevation	766 feet msl

SPILLWAY DESIGN FLOOD

	Original Design
Peak Inflow (cfs)	11,900
Peak Outflow (cfs)	10,750
Volume Runoff (acre-feet)	9,650

OUTLET WORKS

Type	Circular conduit
Tunnel Diameter	36 inches
Tunnel Length (feet)	405
Service Gate, Type	None
Downstream Channel Capacity	225 cfs
Discharge at Spillway Crest	225 cfs

LAND ACQUISITION

Fee Elevation (ft msl)	762
Fee (acres)	456
Easement (acres)	2

MAXIMUM POOL OF RECORD

Date	Feb. 1970
Stage (feet)	18
Elevation (ft msl)	712
Percent Full	7

UNIT RUNOFF

One inch runoff	416 acre feet

PROJECT COST (THROUGH FY 77) — $2,950,000

DATE OF COMPLETION — 1966

MAINTAINED BY — New England Division, Corps of Engineers

MANUAL OF WATER CONTROL
CHICOPEE RIVER WATERSHED
MASSACHUSETTS

CHAPTER I

INTRODUCTION

1. REGULATION MANUAL

a. Authorization. This report is prepared pursuant to authority contained in ER 1110-2-240, dated 22 April 1970, Reservoir Regulation and EM 1110-2-3600, dated 25 May 1959, which requires that manuals of reservoir regulation for flood control, navigation or multipurpose reservoirs be prepared whenever storage allocated to one or more of the functions is the responsibility of the Corps of Engineers. Requirements given in the draft of "A Guide for Preparing Water Control Manuals for Lakes, Reservoirs, Locks and Dams, Hurricane Barriers, Reregulating Structures, Controlled Channels and Floodways, Office, Chief of Engineers," January 1973 were followed in the preparation of this manual.

b. Purpose and Scope. This manual will serve as a guide and reference source for higher authority, reservoir regulation and maintenance personnel in the New England Division Office, respective project managers and other personnel who may become concerned with, or responsible for, regulation of the reservoirs in the Chicopee River watershed. Included in the manual are the following chapters:

(1) Introduction. A brief history of flood problems and studies which led to the authorization of the Chicopee River watershed flood control projects, including statistical data relative to population, industry and agriculture, and a description of the physical features of all Corps projects, Soil Conservation Service projects, and signficant non-Federal projects.

(2) Management. A general description of the functional responsibilities of the Corps in regard to regulation of the projects, with a listing of all interagency coordinating agreements.

(3) Hydrometeorology. A general description of the watershed and major tributaries, including topographic features and a general coverage of the hydrologic and meteorologic data, i.e., temperature, precipitation, snowfall, snow cover, storms, streamflow and floods.

(4) Communications and Data Collection. A brief description of the means of reporting from field to office such as used by the project managers during nonflood and flood periods, and of the river reporting network and Automatic Hydrologic Radio Reporting System.

(5) Hydrologic Forecasts. A description of all forecasts used by Reservoir Control Center personnel in regulating the projects in the basin, including precipitation forecasts from the National Weather Service and river predictions from the River Forecast Center at Bloomfield, Connecticut and the Corps.

(6) Reservoir Regulation. A detailed discussion of the regulation procedures and watershed flood control plan for the two existing flood control dams.

(7) Hydrologic Equipment. A brief resume of hydrologic equipment used and means of maintaining it.

c. Related manuals. Routine operations and maintenance activities at Barre Falls and Conant Brook Dams are performed by the project managers at Barre Falls Dam and Westville Lake, respectively. These managers function under the supervision of the Reservoir Branch of the Operations Division which prepared the Operations and Maintenance Manuals, June 1972, for Barre Falls Dam and Conant Brook Dam. These manuals give essential operation and maintenance instructions to operating personnel for the upkeep, repair, maintenance and operation of project facilities.

2. PROJECT DESCRIPTIONS

a. Location. The Chicopee River watershed (plate G-3) is located in central Massachusetts within the confines of Worcester, Franklin, Hampshire and Hampden Counties.

The Barre Falls Dam (plate G-60) is located in Barre, Massachusetts on the Ware River. The dam is about 32 miles upstream of the confluence of the Ware and Swift Rivers and about 52 miles upstream of the mouth of the Chicopee River.

Conant Brook Dam (plate G-61) is located on Conant Brook in the town of Monson, Massachusetts. This location is about 7 river miles from the Quaboag River, about 12 miles from the confluence of the Quaboag and the Chicopee Rivers and nearly 30 river miles from the mouth of the Chicopee River.

b. Purpose. Both Barre Falls and Conant Brook Dams are operated to reduce flood stages at downstream communities within the watershed. In addition Barre Falls helps to reduce flood stages along the Connecticut River.

MANUAL OF RESERVOIR REGULATION
CHICOPEE RIVER WATERSHED
MASSACHUSETTS

CHAPTER I

INTRODUCTION

1. REGULATION MANUAL

a. Authorization. This report is prepared pursuant to authority contained in ER 1110-2-240, dated 22 April 1970, Reservoir Regulation and EM 1110-2-3600, dated 25 May 1959, which requires that manuals of reservoir regulation for flood control, navigation or multipurpose reservoirs be prepared whenever storage allocated to one or more of the functions is the responsibility of the Corps of Engineers. Requirements given in the draft of "A Guide for Preparing Water Control Manuals for Lakes, Reservoirs, Locks and Dams, Hurricane Barriers, Reregulating Structures, Controlled Channels and Floodways, Office, Chief of Engineers," January 1973 were followed in the preparation of this manual.

b. Purpose and Scope. This manual will serve as a guide and reference source for higher authority, reservoir regulation and maintenance personnel in the New England Division Office, respective project managers and other personnel who may become concerned with, or responsible for, regulation of the reservoirs in the Chicopee River watershed. Included in the manual are the following chapters:

(1) Introduction. A brief history of flood problems and studies which led to the authorization of the Chicopee River watershed flood control projects, including statistical data relative to population, industry and agriculture, and a description of the physical features of all Corps projects, Soil Conservation Service projects, and signficant non-Federal projects.

(2) Management. A general description of the functional responsibilities of the Corps in regard to regulation of the projects, with a listing of all interagency coordinating agreements.

(3) Hydrometeorology. A general description of the watershed and major tributaries, including topographic features and a general coverage of the hydrologic and meteorologic data, i.e., temperature, precipitation, snowfall, snow cover, storms, streamflow and floods.

(4) Communications and Data Collection. A brief description of the means of reporting from field to office such as used by the project managers during nonflood and flood periods, and of the river reporting network and Automatic Hydrologic Radio Reporting System.

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b. Purpose. Both Barre Falls and Conant Brook Dams are operated to reduce flood stages at downstream communities within the watershed. In addition Barre Falls helps to reduce flood stages along the Connecticut River.

c. Physical Components.

(1) Barre Falls Dam. Important project components consist of a rolled earth and rockfill dam, a rock chute-type spillway with concrete ogee weir, 3 dikes located in saddles in the rim of the reservoir, outlet works, storage capacity for flood control.

At spillway crest elevation, 807 feet msl, Barre Falls Reservoir, a dry bed reservoir, has a capacity of 24,000 acre-feet, equivalent to 8.2 inches of runoff from the contributing drainage area of 55 square miles. When filled to spillway crest, the reservoir will have a surface area of about 1400 acres.

The dam embankment, 885 feet in length and maximum height of 60 feet above streambed consists of rock and earthfill and is shown on plate G-7. The top of dam at elevation 830 feet msl provides 18 feet of spillway surcharge and 5 feet of freeboard. A top width of 25 feet accomodates a 16-foot paved access road, and the embankment slopes 1 on 2.0 on the downstream side and 1 on 2.5 on the upstream side of the dam.

There are three dikes, with a maximum height of 48 feet, which total 3,215 feet in length. These dikes constructed of rolled rockfill with an impervious fill upstream blanket, bring elevations up to 830 feet msl in three saddles along the southern rim of the reservoir.

The spillway is located on the right abutment adjacent to the dam. Components of the spillway include the approach channel, discharge channel and a 60 foot long concrete ogee weir with a fixed crest at elevation 807.0 feet msl (46-foot stage). Plan, profile and cross section of the spillway are shown on plate G-8.

The outlet works are in the left abutment and consist of an intake channel and a 9'-8" diameter horseshoe conduit. The conduit is 250 feet long and discharges are controlled by two 4.5 foot wide by 9.0 foot high sluice gates controlled from the control tower. Plan and sections of the outlet works are shown on plate G-7.

(2) Conant Brook Dam. The important physical components include a rolled earth dam and dikes, a chute spillway composed of a concrete ogee weir, outlet works, and storage capacity for flood control. The General Plan for Conant Brook Dam is shown on Plate G-9.

At spillway crest (757 feet msl) Conant Brook Reservoir, a dry bed reservoir, has a flood control storage capacity of 3,740 acre-feet, equivalent to 9.0 inches of runoff from the contributing drainage area of 7.8 square miles. When filled to spillway crest, the reservoir will have a surface area of 158 acres.

The dam embankment, about 1,050 feet in length and maximum height of 85 feet above streambed, consists of rolled earthfill with an impervious core and rock slope protection. The top of dam, elevation 771 feet, provides 9.0 feet of spillway surcharge and 5.0 feet of freeboard. The top width of 20 feet accommodates a 16-foot paved access road and the embankment slopes vary from 1 on 3.0 to 1 on 2.5.

A rolled earthfill dike, located at the north end of the reservoir, is 980 feet in length with a maximum height of 14 feet; the top of the dike is at elevation 771.

The spillway consists of an approach channel, a concrete ogee weir located on the right bank and a discharge channel. The weir has a length of 100 feet with a crest elevation of 757 feet msl. A plan and profile is shown on plate G-10.

The outlet works consist of an inlet channel, a single ungated 36-inch diameter conduit with trash rack to prevent clogging and an outlet channel. The intake channel (plate G-11) is 10 feet wide excavated in rock to elevation 694 feet msl.

THE PROJECT IS UNSTAFFED AND SELF REGULATING.

3. HISTORY OF PROJECTS

a. Authorization. Barre Falls Dam and Reservoir was authorized as a project for the Chicopee River watershed in the Flood Control Act of 18 August 1941 (Public Law No. 228, 78th Congress) and 22 December 1944 (Public Law No. 534, 78th Congress).

Conant Brook Dam and Reservoir was authorized by the Flood Control Act of 1960 (House Document 434, 86th Congress 2nd Session).

b. Construction. Construction on Barre Falls Dam was initiated in 1956 and completed in May 1958. Construction on Conant Brook Dam was initiated in 1964 and completed in September 1966.

c. Corps of Engineers Local Protection Projects. There are five local protection projects in Massachusetts in the Chicopee River watershed. These projects are briefly discussed below and Table G-1 includes pertinent data.

(1) Chicopee. This local protection project, completed in 1958, is located in Chicopee, Massachusetts along the left bank of the Connecticut River and right bank of the Chicopee River. Primarily, it provides protection against flood stages on the Connecticut River, with backwater up the lower Chicopee River. The project consists of 21,700 feet of earth levees and 3,200 feet of concrete flood walls. The system also includes 3 stoplog structures and 5 pumping stations

with appurtenant drainage structures. The project is designed to protect against a flood discharge of 312,000 cfs which is about 15 percent greater than the March 1936 flood of record. Local interests provided the lands, right-of-way, and relocations required for the work and constructed the necessary sewerage facilities. General plans for this project are shown on plate G-12.

(2) Chicopee Falls. This local protection project, completed in 1965, is located on the left bank of the Chicopee River in Chicopee, about 2-1/2 miles above the mouth of the river. At this point, the Chicopee River flows in a circuitous direction - first, from east to west, then south, and then again in a westerly direction. The protection consists of 1,420 feet of concrete floodwalls and about 3,600 feet of earth dikes extending between the Chicopee Dam and high ground owned by the U.S. Rubber Company. Included in this improvement are three stoplog structures, two pumping stations (used to remove storm water runoff and sewage into the Chicopee River during high flows) and some channel alignment. The project is designed for a Chicopee River discharge of 70,000 cfs, which is the standard project flood modified by Barre Falls and Conant Brook Reservoirs. General plans for the local protection project are shown on plate G-13.

(3) Three Rivers. This local protection project is located at the confluence of the Chicopee, Quaboag and Ware Rivers in Palmer, Massachusetts. Consisting of deepening and widening, the channel improvement extends along the Chicopee River for about 2800 feet from the New England Power Company to the confluence of the Chicopee, Quaboag and Ware Rivers. From this confluence, the project continues about 700 feet up the Ware and about 1400 feet up the Quaboag River. The project also includes the removal and/or construction of several appurtenant structures (i.e. bridges, dams, etc.).

Due to the channel restrictions caused by adjacent industrial buildings and bridges, it was only economically feasible to design this project for a flood of 50,000 cfs, equivalent to 72 percent of the SPF. This degree of protection is about 25 percent greater than the maximum flood of record modified by Conant Brook and Barre Falls. Additional information on the project is shown on plates G-14 and G-15.

(4) Ware. This local protection project, completed in 1959, is located in Ware on the Ware River about 21 miles northeast of Springfield and 22 miles west of Worcester, Massachusetts. The project consists of 11,800 feet of channel improvement (straightening, widening and deepening of the Ware River and lower Muddy Brook), thus providing for a greater flow of water through the town. The project also includes the construction of two dikes about 1,100 feet in length and the elimination of accumulated interior runoff by the use of portable pumps owned by the town. Protection is provided for an event

TABLE G-1
PERTINENT DATA
LOCAL PROTECTION PROJECTS
CHICOPEE RIVER WATERSHED

PROJECT LOCATION	CHICOPEE, MA.	CHICOPEE FALLS, MA.	PALMER, MA. (THREE RIVERS)	WARE, MA.	W. WARREN, MA.
RIVER	Connecticut and Chicopee Rivers	Chicopee River	Chicopee, Ware, Quaboag Rivers	Ware River and Muddy Brook	Quaboag River
CHANNEL IMPROVEMENTS					
Lenght (ft)	--------	--------	5200	12,000	1750
Bottom Width (ft)	--------	200 to 250	80 to 200	90	--------
Side Slopes	--------	--------	varied	1 on 2	--------
DIKES					
Length (ft)	21,700	3620	--------	1,800	60
Top Width (ft)	--------	15	--------	18 and 4	3
Side Slopes	--------	1 on 2 & 1 on 2.5	--------	1 on 2 & 1 on 8	1 on 1.5
FLOOD WALLS (ft)	3,200	1420	--------	--------	450
INTERIOR DRAINAGE	5 pumping stations, modification and addition to existing drains	2 pumping stations, modification and addition to existing drains	--------	New flap valve and sluice gate	Modification and addition to existing drains
MISC. FEATURES	3 stoplog structures	3 stop log structures Channel widening and deepening	Channel widening and deepening	----------	Stone slope bank protection and channel improvement
PROJECT FLOOD (cfs)	312,000	70,000	50,000	20,000 - 22,000	11,000
FLOOD OF RECORD (cfs)	272,000 (Mar. 1936)	42,500 (Sept. 1938)	35,500 (Aug 1955)	20,000-22,000(Sept 1938)	8300 (Aug 1955)
FREEBOARD (ft)	3 to 5	3	--------	2	2.6 to 2.7
PROJECT COST(Thru FY78)	$1,988,000	$2,670,000	$2,280,000	$485,000	$454,000
DATE STARTED	1936	1963	1964	1958	1962
DATE COMPLETED	1941	1965	1966	1959	1963
MAINTAINED BY	City of Chicopee	City of Chicopee	Comm. of Mass.	Town of Ware	Town of W. Warren

equal to the flood of record (September 1938) of 20,000 cfs above Muddy Brook, and 22,000 cfs below the brook. The general plan and vicinity map for this project is shown on plate G-16.

(5) West Warren. This local protection project, completed in 1963, provides protection for the highly industrialized section of West Warren along the west bank of the Quaboag River.

The improvements consist of an earth and rockfill dike, concrete floodwalls, channel improvements, reconstruction of an existing bridge, and the removal of two utility bridges. The project provides protection for a standard project flood of 11,000 cfs which is 30 percent greater than the record flood of August 1955. Channel improvements include deepening, widening and clearing of the existing channel. Also, rock slope protection for the banks is provided at many points along the river.

General plans for the West Warren local protection are shown on plate G-17 and profiles are shown on plate G-18.

d. Soil Conservation Service Projects.

(1) General. The Soil Conservation Service (SCS) of the U.S. Department of Agriculture has constructed flood protection projects throughout New England and in the Connecticut River basin. These projects, authorized by the Watershed Protection and Flood Prevention Act, Public Law 566, are associated with small watersheds up to 250,000 acres in area. Water impoundments under the act are limited to 12,500 acre-feet of flood storage and 25,000 acre-feet total storage.

SCS impoundment structures are regulated by an ungated principal spillway which is essentially an overflow weir, as shown on plate G-19. The spillway, located in the outlet structure, is generally designed so that its outflow combined with flood storage will control all events up to and including the 100-year storm. Storms in excess of this will activate an emergency spillway, which is generally a grassed earth spillway built at one or both ends of the dam and discharging downstream from the toe of the retarding structure.

(2) Quaboag River Watershed. In the Quaboag River watershed, the SCS has constructed or has prepared work plans for nine flood protection works. Pertinent data for these projects are listed in table G-2 and plate G-20 shows their locations.

e. Non-Federal Projects.

(1) Massachusetts Metropolitan District Commission Water Supply.

TABLE G-2

SCS PROJECTS IN THE
QUABOAG RIVER WATERSHED

SCS IMPOUNDMENTS

Site	River	Drainage Area	Flood Control Storage		Principal Spillway Max. Discharge Capacity		Emergency Spillway Design Capacity		Storage[1] Purposes	Construction[2] Status
		sq.mi.	Acre/Feet	Inches	CFS	CSM	CFS	CSM		
Moose Hill	Shaw Brook	4.7	1530	6.1	143	30	7000	1490	S,F,R	-
Horsepond	Horsepond Brook	4.1	1396	6.4	105	26	3640	770	S,F,R	C
Kittredge	Fivemile River	1.7	439	4.7	100	51	4200	2470	S,F,R	C
Rice	Trout Brook	3.4	1000	5.6	108	32	3990	1170	S,F	-
Meadow	Sucker Brook	6.3	2358	7.0	138	22	13300	2110	S,F,R	-
Sucker	Sucker Brook	1.6	603	6.9	61	38	3380	2110	S,F	C
Lamberton	Lamberton Brook	4.4	803	3.4	268	61	7200	1640	S,F	C
	Total	26.2	8129	5.0						

SCS CHANNEL IMPROVEMENT

Site	River	Type of Improvement	Construction Status
E. Brookfield, Mass.	E. Brookfield River	Flood Wall	C

(1) S - Sediment, F - Flood Water, WS - Water Supply, R - Recreation
(2) Construction Status : C - Constructed,

(a) General. Large portions of the Swift and Ware River watersheds are controlled by facilities of the Metropolitan District Commission (MDC) of the Commonwealth of Massachusetts as a source of water supply for metropolitan Boston. These facilities consist of the Coldbrook Intake in the Ware River and Quabbin Reservoir in the Swift River watersheds. These projects, discussed in the following paragraphs, control about 283 square miles of drainage area in the two watersheds, and therefore have considerable impact on discharges in the Chicopee River watershed.

(b) Coldbrook Diversion. The Coldbrook Diversion is situated about 4 miles downstream of Barre Falls Dam and controls 96.8 square miles of drainage area of the Ware River. The function of this structure is to normally divert water from the Ware River to Quabbin Reservoir via the Quabbin Aqueduct. Diversion from Coldbrook may also be directed to Wachusett Reservoir in Clinton, Massachusetts, 10 miles northeast of Worcester via this same aqueduct. This is not normally done however, as it is MDC's policy to store water taken from the Ware River in Quabbin Reservoir prior to being released into the MDC water supply.

The normal diversion period is 6 months (1 December to 31 May), but may be extended to 8 months (15 October to 15 June) if approved by the Massachusetts Board of Health. In addition to this restriction, MDC is required by law to allow a minimum discharge of 132 cfs to pass the Coldbrook Intake for use by downstream interests. During diversion, the minimum discharge is obtained by a siphon arrangement which automatically divides the flow into two parts, with the excess over 132 cfs being diverted. Th maximum diversion capacity to Quabbin via the aquaduct is 890 cfs, and combined capacity to both Wachusetts and Quabbin Reservoirs is 2960 cfs. Discharges in both directions are accomplished entirely by gravity.

Discharge measurements for both diversion and riverflow at Coldbrook Intake are obtained by recording flow meters. The elevation of all siphon crests is 650.35 msl (656.0 Boston City Base) with an emergency spillway located on the left bank, 1 foot higher. A schematic of the diversion apparatus is shown on plate G-21.

Headwater elevations may be obtained from a staff gage installed by the Corps on the upstream side of a catwalk that crosses the pool about 20 feet above the dam. The bottom of the staff gage is set at spillway crest elevation (651.35 msl). Stage and discharge values for Coldbrook Intake are generally supplied by MDC personnel who are on duty 8 hours a day, Monday through Friday. During other hours, river stages may be taken from the NED staff gage.

(c) Quabbin Reservoir. The Quabbin Reservoir, shown on plate G-22 impounds water from 186 square miles of the Swift River watershed and, when Coldbrook is diverting, 96.8 square miles of the Ware River. Minimum downstream flow requirements were established by a U.S. Supreme Court decision responding to a suit brought by the State of Connecticut enjoining the Commonwealth of Massachusetts from diverting water from the Connecticut River basin. As a result, during the period 1 June to 30 November, average minimum flow requirements for the Swift River downstream of Windsor Dam will be 110 cfs (71 mgd) when the flow on the Connecticut River at Montague City is 4,650 cfs or less. During this period, when the flow at Montague City is between 4,650 and 4,900 cfs the average minimum flow downstream will be 70 cfs (45 mgd). At all other times, Quabbin Reservoir will pass an average minimum flow of 32 cfs (20 mgd). These minimum discharges are made through outlet works, which include a hydroelectric station at the foot of the dam.

The overflow spillway of Quabbin Reservoir is located beyond a knoll on the eastern end of Windsor Dam. Spillway crest elevation is at 530 feet above Boston City Datum (BCD) or 524.4 feet msl, and total spillway length is 400 feet. Thirty feet of spillway is depressed to 528 feet BCD to allow drawdown of the reservoir in anticipation of spring snowmelt. Stoplogs are then placed along this depressed length once the pool has been lowered. A spillway rating curve with all stoplogs in place is shown on plate G-23 and a photograph of the Quabbin spillway is shown on plate G-24. In the southeastern corner of the reservoir, releases are made from Quabbin to Wachusett Reservoir via the Quabbin aqueduct. This aqueduct, a 13-foot high and 24.6 mile long arch-shaped tunnel excavated in rock, is capable of discharging 925 cfs when Quabbin levels are at spillway crest. Pertinent data on Quabbin Reservoir is shown on table G-3.

f. Modification to Authorization. There have been no modifications to the authorized project plans of Barre Falls or Conant Brook dams.

g. Previous Reports. Public Law 738, 74th Congress, approved 22 June 1936, authorized a 10-reservoir system for the Connecticut River Basin in New Hampshire and Vermont as set forth in House Document 412, 74th Congress, 17 February 1936, " . . . in the interest of flood control, power development and navigation . . ."

Public Law 761, 75th Congress, passed 28 June 1939, approved a comprehensive plan for flood control and other purposes as set forth in House Document 455, 75th Congress. This document increased the reservoirs in the comprehensive plan to twenty, with ten alternatives, and also authorized seven local protection works. The Chicopee Local Protection Project was included in this plan.

TABLE G-3

PERTINENT DATA
QUABBIN RESERVOIR

1.	Location	Belchertown, Hardwick, New Salem, Pelham, Petersham, Shutesbury, Ware
2.	Owner	Mass. Metropolitan District Commission (MDC)
3.	Drainage Area	186 Square Miles
4.	Project Features	
	a. Winsor Dam	
	(1) Type	Rock and Earthfill
	(2) Length	2340 feet
	(3) Maximum Height	170 feet
	(4) Top Elevation	544.4 feet msl = 550 feet above Boston City Datum (BCD)
	(5) Volume	4 million cubic yards
	b. Goodnough Dike	
	(1) Type	Rock and Earthfill
	(2) Length	2140 feet
	(3) Maximum Height	135 feet
	(4) Top Elevation	544.4 feet msl = 550 Ft. (BCD)
	(5) Volume	2.5 million cubic yards
	c. Quabbin Spillway	
	(1) Top Elevation	524.4 feet msl = 530 Ft. (BCD)
	(2) Crest Length	400 feet
	d. Storage	
	(1) Volume	1,300,000 A.F. (131 inches of R.O.)
	(2) Reservoir Area	39.4 Sq. Mi.
4.	Date of Completion	1936

Public Law 22, 77th Congress, passed 18 August 1941, authorized construction of the reservoirs of the comprehensive plan approved by the 1938 act, and modified the plan to include the works recommended by the Chief of Engineers in House Document 724, 76th Congress, 3rd Session. Included in these modifications were plans for the construction of Barre Falls Dam on the Ware River and West Brookfield Dam on the Quaboag River.

Public Law 858, 80th Congress, 2nd Session, 30 June 1948 - Section 205 of this Act authorizes the Secretary of the Army to allot money for the construction of small flood control projects not specifically authorized by Congress. A limit of $100,000 was originally set for the expenditure on any one project; however, this figure has been amended and now stands at $2 million. For areas which had been declared disaster areas within the 5 years prior to project authorization by the Chief of Engineers, an amount of $3 million may be allotted. Studies of projects under this authority must be initiated by local interests and assurances of local cooperation and cost-sharing must be made by them before appropriation of Federal funds for construction can be allotted. Projects undertaken under this authority are commonly called "205 Projects". The local protection projects at Ware and West Warren are 205 Projects.

The New England-New York Interagency Committee (NENYIAC), organized at the direction of the President of the United States on 9 October 1950, made a comprehensive survey of the land, water and related resources of the New England-New York area. The Committee, comprised of six Federal agencies: Departments of Army; Agriculture; Commerce; Health, Education and Welfare; Interior and the Federal Power Commission together with a representative from each of the 7-area states, submitted a report dated 27 April 1956. A summary of this report is published in Senate Document 14, 85th Congress, 1st Session, 17 January 1957.

The Corps of Engineers report: "New England Basins, Report on Flood Control and Allied Purposes," dated 30 June 1955, presented a comprehensive flood control plan for the Connecticut River basin essentially the same as that of the NENYIAC Report.

Public Law 86-645, 86th Congress, 14 July 1960 authorized several projects in the Connecticut River basin as set forth in House Document 434, 86th Congress, 2nd Session, 24 June 1960. Included in this plan was flood protection in the Chicopee River basin which included Conant Brook Dam and Reservoir, and Chicopee Falls and Three Rivers local protection projects.

The Comprehensive Water and Related Land Resources Investigation, Connecticut River basin, completed in June 1970, recommended a basin wide flood control plan which included structural measures to be

prepared by the Corps of Engineers and the Soil Conservation Service. An operational change recommended for Barre Falls included in Appendix M of this report, is discussed below.

Due to severe water quality of the watershed, it was recommended that regulation at Barre Falls Dam be altered to include the retention of a 5,460 acre-foot (1.9 inches) pool for flow augmentation releases. This concept is predicated on secondary treatment facilities first being constructed at the known point sources of pollution. However the state and local agencies have not taken an active interest in this proposal and the study in currently inactive.

h. Flood Plain Information Reports.

(1) General. These reports analyze topographic features and hydrologic history to determine flood potential (i.e., flood plain delineations and frequency of flood stages and discharges). This information, where determined, is available to planning groups, zoning boards, private citizens, real estate or industrial developers and others to determine the wise use of flood plain.

(2) Chicopee River Watershed. Flood Plain Information Reports authorized under Section 206 of the Flood Control Act of 1960 (Public Law 86-645) have been prepared for several communities in the Chicopee River watershed. These communities are tabulated below:

Community	River	Completed
Palmer	Quaboag, Swift and Ware	Sept. 1977
Chicopee, Springfield, Ludlow, Wilbraham and Palmer	Chicopee	Sept. 1973
Monson	Chicopee, Conant Brook	Dec. 1963

i. Flood Insurance Studies. These studies, carried out under provision of the National Flood Insurance Act of 1968 (Public Law 90-448 Title XIII), map communities eligible for the Flood Insurance Program by risk zones and determine insurance rates. Administration of the program is handled by the Department of Housing and Urban Development (HUD), which utilizes services of the private insurance industry with Federal subsidization to provide flood insurance to family dwellings and small business properties and their contents.

As of November 1978, the only community in the watershed which has had a final insurance study prepared and has accepted HUD guidelines for flood plain zoning is the city of Chicopee.

j. Principal Project Problems. There have been no major project problems with the structure or the reservoir area at either Barre Falls or Conant Brook Dams.

4. ECONOMY OF THE WATERSHED

a. General. The economy of the Chicopee River watershed, encompassing all or part of 37 towns and 2 cities, is built around manufacturing. The leading industries which employ close to 60 percent of all manufacturing workers are electronics, fabricated metals, machinery and clothing. A major portion of the industrial activity is concentrated in the south and central sections of the basin and is well distributed in every town and village along the banks of the Chicopee, Ware and Quaboag Rivers.

Agriculture in the Chicopee River watershed is limited to less than 20 percent of the total land area. This is mainly because (1) approximately 16 percent of the drainage area in the vicinity of Quabbin Reservoir (117 squre miles), is owned and utilized by the Commonwealth of Massachusetts for water supply purposes and (2) a large part of the basin is hilly, and the soil rough and stoney. The only noticeable exception is the upper Quaboag River watershed where some poultry raising, dairy farming and apple growing takes place.

Other activities in the watershed include granite quarrying and sand and gravel excavation. In addition, recent forestation and forest management activities are expected to increase potential lumber resources in the basin.

b. Population. Population of the Chicopee River watershed is distributed unevenly throughout the basin, with the largest portion settling in the more urban areas of the lower watershed. Population trends for several cities and towns in the watershed are shown below:

Town or City	1950	1960	1970
Springfield	162,400	174,500	163,900
Chicopee	49,200	61,500	66,700
Barre	3,400	3,500	3,800
Ware	7,500	7,500	8,200
Palmer	9,500	10,400	11,700
Monson	6,100	6,700	7,400
North Brookfield	3,400	3,600	4,000

c. Family Income. The median income for families in Massachusetts for 1970 was $10,835. Towns and cities in the Chicopee watershed were lower than that for the State, with Springfield only $9,612 and Chicopee, the second largest city $9,738.

CHAPTER II

MANAGEMENT

5. GENERAL

a. Project Owner. Both Barre Falls and Conant Brook Dams are owned by the Department of the Army, Corps of Engineers.

b. Operating Agency. The New England Division is responsible for the operation of both projects. Staffing at Barre Falls is on a normal work week, Monday through Friday, 0800 to 1630 hours, and from 0800 to 0900 on Saturday and Sunday, with the project manager at Barre Falls living at the site. During flood emergency conditions, Barre Falls will be staffed on a 24-hour basis or as instructed by RCC for the duration of the emergency.

Conant Brook is the responsibility of the Westville Lake Project Manager. It is his responsibility, through periodic visits to Conant Brook, to check on conditions which might affect regulations at the project.

c. Regulating Agency. The New England Division, Corps of Engineers is responsible for the regulation of both projects.

6. FUNCTIONAL RESPONSIBILITIES

a. Corps of Engineers. Reservoir regulation activities of the New England Division are performed by the Reservoir Control Center (RCC), a section of the Water Control Branch. Administrative and maintenance activities at Barre Falls and Conant Brook are performed by the project managers at Barre Falls and Westville, respectively. Supervision of the project managers is the responsibility of the Reservoir Branch of the Operations Division. This responsibility is facilitated by each project's respective basin manager. However, during regulation periods, the managers are responsible to the Reservoir Control Center, and report directly to the Center for information and instructions.

The Water Control Branch of the Engineering Division is comprised of three sections; namely, Reservoir Control, Hydrologic Engineering and Hydraulics and Water Quality. The RCC consists of a staff of highly trained hydrologic engineers who devote full time to regulation activities of reservoirs in New England. Members of the other sections assist RCC personnel during routine and flood operations, and also provide technical assistance as needed. An organization chart for reservoir regulation in the New England Division is shown on plate G-25.

The RCC is divided into basin units, each responsible for receiving routine hydrologic and meteorologic reports and directing reservoir regulation within an assigned river basin. Each unit consists of regulator in charge of the overall operation in the basin, and project regulators who receive reports during working hours or from their homes during nonworking hours. Whenever severe emergency conditions exist, the RCC staffs NED headquarters to assure 24-hour operations as long as necessary.

b. Other Agencies. There are no other Federal, State, county or private agencies that have any responsibility in regulating the flood control aspects of either Barre Falls Dam or Conant Brook Dam.

7. INTER-AGENCY COORDINATION

a. Inter-Agency Agreements. The Corps of Engineers has cooperative working programs with the U.S. Geological Survey, the National Weather Service and its River Forecast Center at Bloomfield, Connecticut. The Corps uses the hydrologic and forecasting information from these agencies in regulating flood control reservoirs in a manner to provide efficient protection for downstream communities.

b. Compacts. Congress, by the passage of Public Law 52, 83rd Congress, 6 June 1953, granted its consent and approval to an interstate compact, covering the Connecticut River Valley, that had been previously ratified by the States of New Hampshire, Vermont, Massachusetts and Connecticut. The principal purposes of the compact are:

(1) Assuring adequate storage capacity for impounding waters in the interest of flood control. Five dams - Union Village, Surry Mountain, Knightville, Tully and Birch Hill were in operation at the time the compact was instituted. These dams were endorsed by the compact and included in the tax sharing clause. Twelve additional locations were agreed upon for future tax reimbursement if constructed.

(2) A system of tax loss reimbursement was set up so that the southern states would share the tax loss with the northern states from Federal acquisition of lands for any flood control dam and reservoir built in the Connecticut River Valley. A tabulation of this tax reimbursement is indicated as follows.

Recipient State	Percent Tax Loss Reimbursed	Reimbursing State
Vermont	40	Connecticut
Vermont	50	Massachusetts
New Hampshire	40	Connecticut
New Hampshire	50	Massachusetts
Massachusetts	40	Connecticut

(3) Providing a joint or common agency through which the signatory states may effectively cooperate in accomplishing the objectives of flood control and water resources utilization in the basin.

The compact also provides for creation of a commission consisting of three representatives from each of the four states with authority to enter into contracts and agreements and to make such ongoing studies and investigations as may be required in the interest of flood control and in cooperation with Federal agencies.

c. News Releases. It is the policy of the Corps of Engineers to cooperate with the local press and all other forms of news media. This cooperation provides the local communities with information regarding regulation of the Chicopee River projects. The primary source of information regarding the regulation of the projects is the Public Affairs Officer who is responsible for issuing all communities to the press and news media.

Whenever project managers receive requests for information from local news media and private citizens, the manager can give out information pertinent to his project, however, he will not make any flood forecasts. Referrals should be made to RCC for additional information.

CHAPTER III

HYDROMETEOROLOGY

8. DESCRIPTION OF WATERSHED

The Chicopee River watershed, shown on plate G-3, is located in central Massachusetts within the confines of Worcester, Franklin, Hampshire and Hampden Counties. It has a drainage area of 721 square miles and is the largest watershed in the Connecticut River basin. The watershed is generally fan-shaped with a maximum length of about 45 miles and an average width of 16 miles. Relief of the basin varies from elevation 40 feet msl at the mouth of the Chicopee River to elevation 1,720 feet msl at the headwaters of the basin near Princeton, Massachusetts.

The general topography is low, with rolling hills and several upland plains. Many natural lakes and ponds and artificial ponds developed by local power and manufacturing plants are scattered throughout the watershed. The largest of the natural ponds is Quaboag Pond with an area of about 512 acres, while Quabbin Reservoir, the largest man-made lake in the State, has a surface area of 39.4 square miles. The natural and artificial lakes and ponds have a major effect on floodflows in the Chicopee River basin. A schematic profile of the Chicopee River and its tributaries is shown on plate G-26.

The Chicopee River is formed by the Ware and Quaboag Rivers in the community of Three Rivers; the Swift River enters the Ware just upstream of Three Rivers. From Three Rivers, the Chicopee River flows in a general westerly direction to its confluence with the Connecticut River. The Chicopee River from Three Rivers to the Connecticut, includes an additional area of 76 square miles and falls about 260 feet in 18 miles. Major tributaries of the Chicopee are the Ware, Swift and Quaboag Rivers.

The Ware River is formed by the confluence of its East and West Branches in the town of Barre, Massachusetts, and flows in a general southwesterly direction for about 34 miles to its junction with the Quaboag River. The river falls about 450 feet in this distance. Total drainage area at its mouth, including 216 square miles from the Swift River watershed, is 435 square miles. Hills are prominent in the basin and valleys formed by the Ware River are generally steep and narrow and conducive to rapid runoff. However, flows from the upper 55 square miles are controlled by Barre Falls Dam and Reservoir, and additional control of the Ware River is affected by the Metropolitan District Commission Dam and Intake Works at Coldbrook four miles below Barre Falls Dam. The function of the Intake Works is to divert water from the Ware River to Quabbin Reservoir for water supply purposes. The principal tributary of the Ware River is the Swift River.

The Swift River originates at the confluence of its Middle, East and West Branches in Quabbin Reservoir, a major component of the water supply system for metropolitan Boston. Runoff from 186 square miles flows into the reservoir above Winsor Dam (which is maintained and operated by the Metropolitan District Commission), then diverted to Wachusett Reservoir north of Boston. The 39.4 square mile reservoir area comprises 22 percent of the total watershed, and provides a high degree of protection to the Swift River below the dam. Even in the event of a full reservoir at the beginning of a flood, the large amount of surcharge storage significantly reduces the contribution to downstream flood peaks. The Swift River falls about 80 feet in the 9-mile reach between Winsor Dam and its confluence with the Ware River, which is located about 1 mile upstream of the community of Three Rivers.

The Quaboag River watershed has a drainage area of 210 square miles and a 26 mile length from Quaboag Pond to Three Rivers. In the upper part of the basin, the Quaboag River flows through a large swampy river channel. Valley storage in this area of ponds and flat marsh land is very great, and during flood periods large volumes of water are temporarily stored in this natural basin. The stored floodwaters subside gradually at relatively low rates so that the natural topography produces a flood reduction effect somewhat similar to that of an ungated dam and reservoir. The middle reach of the Quaboag River has a relatively steep slope, but the lower river, downstream of the mouth of the Chicopee Brook, is flat. The river fall from West Brookfield to Three Rivers is about 300 feet. The table on page i in the front of the manual lists the principal tributaries of the Chicopee River.

9. CLIMATE AND RUNOFF

a. Precipitation. The mean annual precipitation over the watershed is about 44 inches and is distributed uniformly throughout the year. Average monthly precipitation at Ware, Massachusetts varies from a minimum of 3.4 inches in February to a maximum of 4.6 inches in August. Extremes in monthly precipitation at Ware vary from a minimum of 0.62 inch in February 1957 to a maximum of 20.88 in August 1955. Monthly precipitation records for four stations in or near the watershed are listed in table G-4. Annual precipitation for the same stations are shown on plate G-27.

b. Temperature. The average annual temperatures vary from 45° Fahrenheit in the hilly regions to 50° in the valleys. Recorded temperature extremes at representative stations within or adjacent to the watershed have varied from a maximum of 104° to a minimum of -22°. Table G-5 lists the mean, monthly and the absolute maximum and minimum temperatures at three stations in or adjacent to the watershed.

TABLE G-4

MONTHLY PRECIPITATION
CHICOPEE RIVER WATERSHED
(Depth in Inches)

Month	Barre Falls Dam, Mass. Elevation - 910 Feet msl (1959 - 1976)			Ware, Mass. Elevation - 410 Feet msl (1928 - 1976)		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
January	2.69	5.75	1.00	3.31	6.67	1.01
February	2.62	4.55	0.88	3.04	5.21	0.62
March	2.92	5.06	1.08	3.82	7.55	1.49
April	3.25	5.07	1.07	3.88	6.79	0.71
May	3.46	7.10	0.98	3.47	6.58	0.74
June	3.49	6.75	1.50	3.55	9.04	1.32
July	3.59	7.25	0.61	3.84	7.94	0.76
August	3.09	6.95	0.60	4.60	20.88	0.71
September	3.66	9.90	1.34	3.61	14.13	0.96
October	3.02	6.38	0.63	3.69	8.85	0.71
November	3.77	6.42	0.85	4.08	6.61	0.85
December	3.78	8.90	1.96	3.94	7.93	0.83
Annual	39.38	53.64	26.24	44.70	60.02	26.45

Month	E. Brimfield Lake, Mass. Elevation - 680 Feet msl (1961 - 1976)			Hardwick, Mass. Elevation - 990 Feet msl (1885 - 1895, 1919 - 1976)		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
January	3.18	5.46	1.20	3.40	7.31	0.74
February	3.35	5.67	1.01	3.04	7.50	0.85
March	3.71	7.52	1.85	3.61	9.64	0.98
April	3.21	5.52	0.86	3.58	7.69	0.69
May	3.72	6.42	1.31	3.63	7.02	1.12
June	3.68	8.03	1.02	4.15	12.38	0.72
July	3.33	5.39	0.91	4.33	9.63	0.90
August	3.15	6.46	1.55	4.28	17.94	0.63
September	4.24	9.99	1.61	4.09	14.54	1.17
October	3.12	5.61	0.92	3.36	8.27	0.12
November	4.13	6.16	0.69	4.01	7.27	0.97
December	4.78	9.93	2.52	3.59	8.34	0.67
Annual	43.64	61.05	31.70	44.92	60.67	30.50

TABLE C-5

MONTHLY TEMPERATURE
CHICOPEE RIVER WATERSHED
(Degrees Fahrenheit)

Month	SPRINGFIELD, MASS. 73 Years of Record Through 1976			BARRE FALLS DAM, HUBBARDSTON, MASS. 17 Years of Record Through 1976			WESTOVER FIELD, MASS.(1) 22 Years of Record Through 1964		
	Mean	Absolute Maximum Recorded	Absolute Minimum Recorded	Mean	Absolute Maximum Recorded	Absolute Minimum Recorded	Mean	Absolute Maximum Recorded	Absolute Minimum Recorded
January	26.8	68	-18	20.6	60	-22	25.1	65	-21
February	27.9	74	-18	21.9	63	-22	27.1	65	-18
March	36.7	87	-11	29.7	73	-6	36.0	86	-13
April	48.5	93	10	42.9	89	6	47.4	87	13
May	59.5	97	27	53.5	92	23	57.9	93	29
June	68.4	101	32	62.8	90	29	67.2	102	37
July	73.3	104	30	67.1	93	38	72.1	97	45
August	71.5	102	39	65.1	95	28	69.9	100	36
September	63.7	102	26	57.8	90	24	62.2	101	27
October	53.4	90	20	47.7	84	13	52.5	89	17
November	42.1	83	4	37.4	72	6	41.1	81	8
December	30.4	66	-16	25.3	65	-14	27.8	64	-15
ANNUAL	50.2	104	-18	44.4	90	-22	48.9	102	-21

(1) Station Discontinued in February 1964

c. Snow and Snow Cover. The average monthly snowfall at Barre Falls Dam, East Brimfield Lake and Springfield are shown in table G-6. Barre Falls and East Brimfield can be considered representative of the headwater region of the watershed, and Springfield is indicative of the lower portion of the watershed.

Snow surveys have been taken by the Corps of Engineers in the upper Chicopee River watershed since 1958. These surveys determine the water equivalence and density of snow cover and hence the runoff potential of the watershed due to snowmelt. The project managers relay this data to RCC, where it is analyzed with similar information from other basins. A weekly snow bulletin is also prepared for Corps use from the end of January through the end of the snowmelt period.

d. Storms. The watershed has experienced storms of four general types, namely:

(1) Extratropical continental storms which move across the basin under the influence of the "prevailing westerlies".

(2) Extratropical maritime storms which originate and move northward along the eastern coast of the United States.

(3) Storms of tropical origin, some which attain hurricane magnitude.

(4) Thunderstorms produced by local convective action or by more general frontal activity.

The most severe storms have been of tropical origin which occur during the late summer and early autumn. The four most serious storms in the watershed in recent years occurred in November 1927, March 1936, September 1938 and August 1955. The events of November 1927, September 1938 and August 1955 were of tropical origin.

e. Runoff

(1) Discharge Records. There are nine USGS gaging stations in the watershed (locations are shown on plate G-3). The period of record for these stations is listed on page i at the front of the manual. A daily hydrograph for the Chicopee River at Indian Orchard from 1936 to 1961 is shown on plate G-29.

(2) Streamflow Data. Average annual runoff for the 49 year period of record for the gage at Indian Orchard is 17.9 inches, with a maximum of 38.9 inches in water year 1938, and a minimum of 7.5 in water year 1966. The mean annual runoff represents about 40 percent of the mean annual precipitation with about 50 percent of this runoff occurring during February through May. The peak discharge for the

TABLE G-6

MONTHLY SNOWFALL
CHICOPEE RIVER WATERSHED
(Depth in Inches)

Month	Barre Falls Dam Hubbardston, Massachusetts 18 Years of Record through 1977		East Brimfield Lake Sturbridge, Massachusetts 15 Years of Record through 1977		Springfield, Massachusetts 82 Years of Record through 1977	
	Mean	Percent of Annual	Mean	Percent of Annual	Mean	Percent of Annual
January	14.6	24.3	15.0	23.3	12.7	26.1
February	16.6	27.7	17.0	26.4	13.8	28.4
March	10.8	18.0	12.1	18.8	9.4	19.3
April	2.4	4.0	2.9	4.5	1.7	3.5
May	T	0.0	0.1	0.1	T	0.0
June	0.0	0.0	0.0	0.0	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0
October	0.2	0.3	0.3	0.5	0.0	0.0
November	1.4	2.3	3.5	5.4	2.3	4.7
December	14.0	23.4	13.5	21.0	8.7	17.9
ANNUAL	60.0	100.0	64.3	100.0	48.6	100.0

TABLE G-7

CORPS OF ENGINEERS
SNOW SURVEY COURSES
CHICOPEE RIVER BASIN, MASSACHUSETTS

Station	River	Elevation (msl)	Location (Lat.)	Location (Long.)	Period of Record
Barre Falls	Ware	820	42-26	72-02	Jan. 1958 - Present
Hubbardston	Ware	1020	42-29	72-01	Jan. 1958 - Present
Princeton	Ware	1400	42-29	71-53	Jan. 1961 - Present
Petersham	Swift	990	42-29	72-11	Jan. 1961 - Present
Rutland	Ware	1040	42-24	71-58	Jan. 1958 - Present
West Brookfield	Quaboag	650	42-13	72-07	Jan. 1958 - Present
Wales	Quaboag	1000	42-04	72-14	Jan. 1961 - Present
Leicester	Quaboag	1050	42-17	71-55	Jan. 1958 - Present
Spencer	Quaboag	1050	42-12	71-59	Jan. 1961 - Present

TABLE G-8
MONTHLY RUNOFF
CHICOPEE RIVER WATERSHED

Ware River
near Barre, Mass.
(D.A. = 55 sq. mi.)
1946-1977

Month	Average CFS	Average Inches	Maximum CFS	Maximum Inches	Minimum CFS	Minimum Inches
January	95	2.0	204	4.1	16	0.3
February	103	2.0	271	5.2	31	0.6
March	172	3.6	338	7.1	69	1.4
April	233	4.7	427	9.0	82	1.6
May	123	2.6	216	4.5	42	0.9
June	64	1.3	175	3.6	14	0.3
July	31	0.6	91	1.9	5	0.1
August	24	0.5	169	3.5	2	0.1
September	26	0.5	275	5.6	2	0.1
October	43	0.9	233	4.9	4	0.1
November	74	1.5	230	4.8	7	0.2
December	97	2.0	204	4.3	13	0.3
Water Year	91	22.5	133	32.8	30	7.4

Ware River
at Gibbs Crossing
(D.A. = 199 sq. mi.)
1912-1977

Month	Average CFS	Average Inches	Maximum CFS	Maximum Inches	Minimum CFS	Minimum Inches
January	302	1.8	728	4.3	62	0.4
February	300	1.6	802	4.3	89	0.5
March	553	3.2	1838	10.7	211	1.2
April	617	3.5	1394	7.9	231	1.3
May	379	2.2	731	4.3	156	0.9
June	238	1.3	603	3.4	65	0.4
July	156	0.9	714	4.1	37	0.2
August	120	0.7	890	5.2	26	0.2
September	136	0.8	1707	9.9	15	0.1
October	142	0.8	750	4.4	29	0.2
November	235	1.3	922	5.2	34	0.2
December	285	1.6	736	4.2	61	0.3
Water Year	288	19.8	581	40.0	107	7.4

Quaboag River
at West Brimfield
(D.A. = 151 sq. mi.)
1913-1977

Month	Average CFS	Average Inches	Maximum CFS	Maximum Inches	Minimum CFS	Minimum Inches
January	255	2.0	587	4.5	49	0.4
February	268	1.9	748	5.3	65	0.4
March	491	3.8	1399	10.8	207	1.6
April	548	4.1	1352	10.1	173	1.3
May	315	2.4	573	4.4	108	0.8
June	179	1.3	655	4.9	47	0.4
July	107	0.8	524	4.0	18	0.1
August	105	0.8	1440	11.1	13	0.1
September	111	0.8	1369	10.2	12	0.1
October	115	0.9	607	4.8	12	0.1
November	172	1.3	695	5.2	27	0.2
December	234	1.8	600	4.6	49	0.4
Water Year	241	21.9	430	39.0	104	9.4

Chicopee River
at Indian Orchard
(D.A. = 688 sq. mi.)
1928-1977

Month	Average CFS	Average Inches	Maximum CFS	Maximum Inches	Minimum CFS	Minimum Inches
January	921	1.6	2447	4.1	221	0.4
February	970	1.5	2374	3.7	332	0.5
March	1615	2.7	5993	10.1	686	1.2
April	1851	3.0	4117	6.7	636	1.0
May	1183	2.0	2680	4.5	471	0.8
June	776	1.3	2475	4.0	229	0.4
July	490	0.8	2458	4.1	159	0.3
August	436	0.7	3719	6.3	176	0.3
September	513	0.8	5474	9.0	160	0.3
October	487	0.8	1953	3.3	131	0.2
November	702	1.1	3022	4.9	154	0.2
December	841	1.4	2278	3.8	241	0.4
Water Year	901	17.9	1952	38.9	376	7.5

period of record reached 42,500 cfs on 21 September 1938. The minimum average daily flow was 16 cfs on several occasions during the period 1929 to 1931. The average annual flow for the period of record at Indian Orchard is 901 cfs.

A summary of the maximum, minimum and average monthly and the average annual runoff for selected USGS gaging stations are shown in table G-8. Annual runoff for each station is listed on plate G-30. A summary of runoff data is also shown on pertinent data sheet 1. Rating tables for the USGS gages at Indian Orchard, and Barre and several points along the Connecticut River are shown on plates G-31 through G-35.

f. Frequency Analysis

(1) Peak Discharge Frequency. The natural frequency of occurence of discharges was determined for selected U.S. Geological Survey gaging stations and is shown in table G-9. Frequency analyses were made in accordance with procedures in ER 1110-2-1450, "Hydrologic Frequency Estimates", dated 10 October 1962. Following a regional frequency analysis, a skew coefficient of 1.0 was adopted for all tributaries of the Connecticut River. The discharge frequency data shown in table G-9 was prepared for the Comprehensive Water and Related Land Resources: Connecticut River Basin in June 1970, and is based on discharge data which was collected through 1963.

TABLE G-9

NATURAL PEAK DISCHARGE FREQUENCY DATA
CHICOPEE RIVER WATERSHED

Expected Probability Percent Chance	Recurrence Interval Years	Chicopee R. at Indian Orchard (cfs)	Ware R. at Gibbs Crossing (cfs)	Quaboag R. at West Brimfield (cfs)
0.5	200	48,000	19,300	8,100
1.0	100	35,500	14,500	6,300
2.0	50	26,000	10,800	4,900
5.0	20	17,000	7,100	3,400
10.0	10	12,000	5,200	2,600
20.0	5	8,450	3,700	1,900
50.0	2	5,100	2,450	1,270
99.0	1	3,400	2,020	1,030

(2) Frequency of Reservoir Fillings. The pool stage at Barre Falls Dam has equalled or exceeded 781 feet msl, which is a about 7 percent of total flood control storage capacity, 19 times from the beginning of operations in July 1958 through June 1978.

TABLE G-10

SIGNIFICANT RESERVOIR STORAGES

BARRE FALLS DAM
1958-1978

Date	Maximum Elevation	Storage Utilized		
		Inches	Acre-Feet	Percent
1959 Apr	783.9	1.0	2,810	12
1959 Jul	783.0	0.9	2,450	11
1959 Oct	783.4	0.9	2,600	11
1960 Apr	797.9	4.5	13,000	55
1962 Apr	789.0	1.9	5,500	23
1963 Apr	783.2	0.9	2,500	11
1966 Feb	781.5	0.7	1,900	8
1966 Mar	784.4	1.1	3,025	13
1967 Apr	782.2	0.7	2,125	9
1968 Mar	788.8	1.9	5,400	22
1970 Apr	784.4	1.1	3,025	13
1972 Mar	781.0	0.6	1,700	7
1973 Jan	781.6	0.7	1,910	8
1973 Feb	782.1	0.7	2,100	9
1973 Dec	784.7	1.1	3,150	14
1975 Sep	784.9	1.1	3,200	14
1976 Jan	785.3	1.2	3,420	15
1977 Mar	786.1	1.3	3,950	16
1978 Jan	784.2	1.0	2,940	12

CONANT BROOK DAM
1966-1978

Date	Maximum Stage	Storage Utilized		
		Inches	Acre-Feet	Percent
1968 Mar	17.6	0.5	225	7
1970 Feb	18.0	0.6		7
1970 Apr	15.0	0.4	150	4
1973 Feb	16.6	0.5	195	6
1973 Dec	16.7	0.5	195	6
1975 Sep	17.2	0.5	200	6
1976 Jan	17.8	0.5	235	7
1978 Jan	16.5	0.5	190	6

The pool stage at Conant Brook has equalled or exceeded 15 feet, which is about 4 percent of total flood control storage capacity, 8 times from the beginning of operations in September 1966 through June 1978.

A tabulation of these operations, with the amount of floodwaters stored, is given in table G-10. The area-capacity table and area-capacity and percent full curves are shown on plate G-36 to G-38 for Barre Falls Dam and on plates G-39 to G-41 for Conant Brook Dam.

10. CHANNEL AND FLOODWAY

During the non-growing season, the channel capacity downstream of Barre Falls Dam on the Ware River is approximately 1000 cfs. During the growing season, approximately late April to October, this value drops to about 600 cfs.

Principal damage centers in the watershed during past floods have been at Ware and Hardwick along the Ware River and Chicopee and Palmer along the Chicopee River area. Important index stations in the watershed are the staff gage on the Route 32 highway bridge in Barre Plains (drainage area = 115 square miles), the USGS gage at the Coldbrook diversion (drainage area = 96.8 square miles) and the USGS gaging station at Indian Orchard (drainage area = 688 square miles). On the Connecticut River, the National Weather Service gage at Springfield is monitored by RCC for the regulation of projects to maintain stages on the mainstem.

In general Barre Falls is regulated to try and keep stages below 5.5 feet during the non-growing season and below 2.5 feet during the growing season. The Coldbrook Diversion is capable of diverting 890 cfs to Quabbin Reservoir and diverting 2960 cfs to both Quabbin and Wachusett Reservoir simultaneously. However this is rarely done. Ware River water is often highly colored particularly during periods of high flow, and is normally diverted only to Quabbin Reservoir which acts as a large settling basin. Therefore, it is evident that the magnitude of releases will be governed by conditions downstream of Coldbrook during nondiversion periods. Releases from Barre Falls bringing downstream flows up to maximum channel capacity should be made during Phase III regulation, provided these releases do not exceed inflow into the reservoir.

Releases from Conant Brook Reservoir are automatically limited by the size of the outlet conduit. Maximum discharges through the outlet will not exceed 225 cfs, which is considered to be the downstream channel capacity.

11. FLOODS OF RECORD

a. General. History of flooding in the watershed has shown that floods occur at anytime of year. The floods of November 1927, September 1938 and August 1955 were caused by heavy rainfall, while the event of March 1936 was caused by heavy rainfall associated with warm weather and considerable snowmelt.

b. Historic Floods. Few records are available of serious flooding prior to 1927; however, the watershed experienced damaging flooding during February 1807, September 1828, May 1854, April 1869, October 1869, April 1895, March 1896 and February 1900.

c. Recent Flooding. In recent years, four significant floods have been experienced, and occurred in November 1927, March 1936, September 1938 and August 1955. Each event is described below.

(1) November 1927 Flood. A tropical storm formed over the Carribean late in October 1927, started northward 1 November and was at the lower end of Chesapeake Bay by 3 November. The storm followed a path over western Massachusetts and Vermont, causing the greatest flooding on the Vermont tributaries of the Connecticut River with serious flooding in New Hampshire and the western tributaries of Massachusetts. Storm rainfall was excessive in the Chicopee River watershed, causing the river to rise to above bankfull in many areas. Storm rainfall for 2-4 November at Ware, Hardwick and Hubbardston was 4.4, 4.5 and 4.1 inches, respectively, and the 24-hour rainfall at each of these stations was 4.1, 4.5 and 3.9 inches, respectively. Peak flows during this storm at the Ware River at Gibbs Crossing, the Swift River at Ware and the Quaboag River at West Brimfield were 14.3, 12.0 and 7.9 cubic feet per second per square mile of drainage area (csm), respectively. Total volume of runoff at the Gibbs Crossing gage for the period 3-10 November was 1.9 inches.

(2) March 1936 Flood. After the first week of March 1936, temperatures in New England became unseasonably warm and continued for the remainder of the month. Snow cover in the upper and central parts of the Connecticut River basin was above average as little thawing had occurred in January and February. During the period 9-22 March, three storm centers passed over New England, with heavy rainfall on 11-12 and 17-18 March. The total storm rainfall at Hardwick, Hubbardston and Ware were 7.3, 7.0 and 5.3 inches, respectively. Water equivalent of the snowmelt during this period was estimated at about 4 inches. Peak flows during this period at Chicopee River at Bircham Bend (drainage area = 704 square miles), Ware River at Gibbs Crossing, Swift River at Ware and Quaboag River at West Brimfield were 29.0, 52.3, 40.8 and 24.0 csm, respectively. For the month, approximately 9.8 inches total runoff passed the gage at Bircham Bend.

The Connecticut River at Hartford crested at 37.6 feet, the greatest flood in over 300 years of record, and from Fifteen Mile Falls to its mouth all previously known flood discharges were exceeded except in that part of the river just downstream of White River Junction, Vermont where the peak was less than that of the November 1927 flood.

(3) September 1938 Flood. This event produced the greatest flood of record along the Ware, Swift and Chicopee Rivers. Antecedent rainfall and runoff had filled many natural storage areas in the basin by the time of the most intense rainfall. As a result, the time sequence of this hurricane was conducive to high peak discharges. Total rainfall for the period 12-22 September for Hardwick, Hubbardston and Ware was 11.4, 15.6 and 12.8 inches, respectively. Maximum 24-hour rainfall at each of these stations was 5.4, 10.2 and 6.0 inches, respectively. Peak flows during this storm at the Chicopee River at Bircham Bend, the Ware River at Gibbs Crossing, the Swift River at Ware and the Quaboag River at West Brimfield were 64.2, 114.1, 29.5 and 56.1 csm, respectively. For the period 20-25 September 6.0 inches of runoff occurred at the Chicopee River at Bircham Bend. Plate G-42 shows the natural flood hydrograph and the hydrograph as modified by Barre Falls and Conant Brook Reservoir at three locations in the watershed.

This flood was the second largest on the lower Connecticut River and the greatest of record on many tributaries in the central and lower portions of the basin.

(4) August 1955 Flood. Although not as large as the 1938 event in most areas of the Chicopee watershed, the August 1955 flood produced the greatest flows of record along the Quaboag River. This event was brought about by two hurricanes occurring within a few days of each other. The first, hurricane "Connie", maintained a rather uniform rainfall rate during the period 11-14 August and, owing to dry antecedent ground conditions, did not produce an exceptional amount of runoff. The second storm, hurricane "Diane", produced intense rainfall from 17-20 August especially in southern portions of the watershed and caused serious flooding as a result. Rainfall totals for Ware and Springfield were 19.2 and 20.9 inches, respectively and maximum 24-hour rainfall for these two stations, respectively, were 14.0 and 11.5 inches on 19 August. Peak discharges at the Chicopee River at Indian Orchard, the Ware River at Gibbs Crossing and the Quaboag River at West Brimfield were 61.3, 80.7, 84.8 csm, respectively. Total runoff for the period 18-30 August at West Brimfield and Indian Orchard was 9.5 and 8.9 inches, respectively.

Plate G-43 shows the natural flood hydrograph and the hydrograph as modified by Barre Falls and Conant Brook Reservoirs at three locations in the watershed.

Due to the path of the storm, no heavy precipitation occurred above the Massachusetts-Vermont-New Hampshire state line, and the flooding occurred in the southern part of the Connecticut River basin. Record breaking floods occurred in many of the southern tributaries; and the Connecticut River at Hartford recorded the third highest stage-30.6 feet for a discharge of 200,800 cfs.

12. ANALYSIS OF FLOODS

a. Chicopee River. The floods of record were analyzed in detail to determine the hydrologic development of floods in the Chicopee River watershed. The runoff characteristics of significant tributaries were appraised with a view of finding the relative timing and discharge contributions at the principal index points along the main rivers within the watershed, as well as the major damage centers on the Connecticut River. The analysis of record floods resulted in the following conclusions:

(1) Flooding may occur on the Chicopee River or its two principal tributaries, the Ware and Quaboag Rivers, at any time of the year.

(2) Major floods on the Chicopee River may be caused by large contriubtions from the Ware River as in September 1938 or the Quaboag River as in August 1955.

(3) A major flood occurring simultaneously on both the Ware and Quaboag Rivers could produce a Chicopee River flood exceeding any that has yet been experienced.

(4) The large surcharge storage in Quabbin Reservoir eliminates any appreciable contribution from the upper Swift River to downstream flood peaks.

(5) The upper Ware River receives a relatively high degree of protection from Barre Falls Reservoir and to a certain extent, by Coldbrook diversion. Below Barre Falls Dam, the middle and lower portions of the basin are capable of producing high runoff. This was illustrated by the August 1955 flood when the lower Ware River experienced the second greatest flood of record although the contribution from the upper part of the basin was minor.

(6) Numerous lakes and extensive valley storage in the Quaboag River watershed upstream of West Brookfield have a significant effect on reducng and retarding flood runoff. As a result, the contribution from this area to downstream flood crests is relatively small.

(7) Topography of the lower Quaboag River between West Brookfield and Palmer is conducive to the formation of high flood peaks. Many small streams, with relatively short times of concentration, enter the Quaboag River in this 11-mile reach. Runoff from these streams is primarily responsible for producing flood peaks on the Quaboag River at Three Rivers.

(8) Peak flow of the Quaboag River at Three Rivers usually precedes that of the Ware River by about 3 to 6 hours. However, there is a possibility that the two peaks could coincide, thereby producing higher stages at Three Rivers and along the Chicopee River. Runoff from the 30 square miles of the Swift River between Winsor Dam and the mouth attains its maximum rate of discharge at Three Rivers several hours before either the Ware or Quaboag Rivers.

(9) During large floods the peak discharge of the Chicopee River changes very slightly as the flood crest moves downstream from Three Rivers to its mouth.

b. Connecticut River. Flooding along the Connecticut River is caused be excessive rainfall, melting snow or a combination of both. Analyses of record floods reveal that Connecticut River floods have generally originated in one of the following manners: (1) as a general basinwide flood, usually with snowmelt, (2) in the northern portion upstream of White River Junction, (3) in the central portion between White River Junction and Montague City, and (4) in the southern portion downstream of Montague City. The November 1927 event occurred in the central and upper portions of the basin, the March 1936 flood was basinwide, the September 1938 flood originated in the lower and central portions of the basin, the flood of August 1955 was a lower basin event, and the April 1960 event was caused by considerable rainfall and snowmelt throughout the basin.

13. DESIGN FLOODS

a. Spillway Design Flood

(1) Barre Falls Design Criteria. As presented in the "General Design Memorandum" dated 1956, a maximum predicted storm upstream of Barre Falls Dam was determined based on Hydrometeorological Report 23 developed by the National Weather Service. The spillway design flood was determined by applying a computed 3-hour unit hydrograph to the maximum predicted storm. Total spillway design storm rainfall, 21-hour duration, was 22.36 inches (infiltration = 1.05 inches). The reservoir inflow and outflow peaks were 68,300 and 16,300 cfs, respectively, for the spillway design flood.

TABLE C-11

SPILLWAY DESIGN CRITERIA
BARRE FALLS DAM AND CONANT BROOK DAM

Item	Barre Falls Design Criteria	Barre Falls 1967 Review	Conant Brook Design Criteria
Drainage Area (sq. mi.)	55		7.8
Spillway Design Storm			
Basis of Design	HR #23,28	HR #33	HR #33
Volume of Rainfall (in.)	22.4	20.1	24.4
Total Losses	1.1		1.2
Storm Duration	21		24
Unit Hydrograph			
Unit Rainfall Duration (hrs)	3	3	2
Peak Flow (cfs)	4380	4380	1,000
Spillway Design Flood (SDF)			
Peak Inflow to Reservoir (cfs)	68,300	61,000	11,900
Volume of Runoff (ac-ft)	65,200	55,500	9,650
Peak Outflow (total cfs)	16,300	14,500	11,000
SDF Reservoir Reg. Plan			
Initial Pool Condition	Full	Full	747
Outlet Facility, During Flood	Closed	Closed	Operable
Max. Surcharge Elev. (ft msl)	825	823.8	766
Freeboard Characteristics			
Design Wind Velocity (mph)	60	80	80
Effective Fetch (miles)	1.2	1.2	0.35
Average Depth (ft)	--	25	--
Wave Runup (ft)	4.1	4.5	2.2
Wind Tide (ft)	0.2	0.4	Negligible
Adopted Freeboard (ft)	5.0	5.0	5.0
Top Elevation of Dam (ft msl)	830	828.8	771

Spillway design requirements included: pool at spillway crest at start of spillway desin flood, gates closed during entire flood period and maximum wave heights occurring at time of maximum spillway discharge. A summary of design criteria for Barre Falls is presented in table G-11 and regulation during the spillway design flood is illustrated on plate G-44.

(2) Barre Falls 1967 Criteria. In April 1967, a review was made of the older reservoir projects to determine whether their hydrologic design criteria conformed adequately with current policies and criteria with respect to safety and functional reliability. Results of the Barre Falls re-analysis indicated that the original spillway design flood was more severe, and hence was sufficient to meet current design criteria. A summary of 1967 criteria for the spillway design flood is listed in table G-11.

(3) Conant Brook Design Criteria. "Design Memorandum No. 1", March 1963 computed a spillway design flood using a synthetic 2-hour unit hydrograph and a maximum predicted storm as determined from Hydrometeorological Report 33, dated April 1956 and prepared by the National Weather Service. Total maximum probable precipitation, 24-hour duration, was 24.4 inches (infiltration = 1.2 inches and rainfall excess = 23.2 inches). The reservoir inflow and outflow peaks were 11,900 and 11,000 cfs, respectively, for the spillway design flood.

This project is relatively new and the spillway design criteria is nearly the same as current criteria. A summary of design criteria is presented in table G-11 and regulation during the spillway design flood is illustrated on plate G-45.

b. Standard Project Flood. This design flood was prepared for the "Interim Report on Review of Survey, Chicopee River Basin, dated 8 September 1959; it was developed to demonstrate the flood producing potentiality of the basin, and also provide a basis for design of local protection projects. It was developed using standard project storm rainfall and unit hydrographs developed from an analysis of floods of record. Unit hydrographs used for the Chicopee River watershed exclusive of the upper reaches of the Ware River were derived from the August 1955 flood. On the upper reaches of the Ware River data from the September 1938 flood, which substantially exceeded the 1955 event, was used for the derivations of unit hydrographs.

A standard project storm for the watershed was centered on the drainage divide between the Ware and Quaboag Rivers. This location produced the most critical runoff conditions in the Chicopee River and was used to determine the most severe flooding in those areas where local protection was being considered.

Peak discharge of the standard project flood on the Chicopee River at Indian Orchard, Massachusetts is 77,800 cfs, which is nearly twice the peak of the 1955 flood of 40,500 cfs, and of the 1938 flood of 45,200 cfs.

Natural and modified hydrographs at selected locations for this flood are shown on plate G-46.

14. FLOOD DAMAGES

a. General. In the last 75 years, the three largest basinwide floods occurred in March 1936, September 1938, and August 1955. The events have been hydrologically described in previous paragraphs. The "Interim Report on Review of Survey - Chicopee River Basin," dated 8 September 1959, describes flood damage data for the 1938 and 1955 floods in Appendix C - Flood Losses and Benefits.

b. Experienced Losses. The following tabulation briefly summarizes experienced flood damage data in the respective year dollars for the 1936, 1938, and 1955 events along the Ware River from Barre to Three Rivers, and along the Chicopee River.

Event	Experienced Flood Losses		
	Ware River ($1,000)	Chicopee River ($1,000)	Total ($1,000)
March 1936	2,300	400	2,700
September 1938	3,740	2,900	6,640
August 1955	1,030	6,500	7,530

It is noted that all Corps flood control projects in the watershed were constructed after the 1955 flood. In addition, stage-damage curves based on field reconnaisance have not been updated since the 1959 Interim Survey Report was prepared.

c. Experienced Flood Levels or Discharge. Experienced flood conditions at selected index stations are summarized for reference purposes.

Index Gage[1]	Drainage Area (sq.mi.)	Flood Event: September 1938	March 1936	August 1955
Coldbrook Div.	96.8	14,000 cfs	5,990 cfs	652.4 ft msl
Barre Plains[2]	115	590 ft msl	583 ft msl	577 ft msl
Gibbs Crossing	199	22,700 cfs 18.2 ft stage	11,200 cfs 12.0 ft stage	12,200 cfs 12.8 ft stage
Indian Orchard	688	---	---	40,500 cfs 22.1 ft stage
Bircham Bend	703	45,200 cfs	20,400 cfs	---

Notes:

(1) Additional information on the index gages associated with reservoir regulation activities can be found in paragraphs 18 and 30.

(2) The zero datum of the Barre Plains staff gage is at elevation 569.7 ft msl. This indicates the 1938 event reached a stage of about 20 feet at the gage.

d. Existing Benefit Analysis. Following each flood event, RCC determines the modifying effects of Corps projects at downstream locations. Natural flows and stages are computed for index damage zones along the Ware, Chicopee and Connecticut Rivers. The Economic and Social Analysis Branch of Planning Division determines benefits at each zone associated with reservoirs and local protection projects. A "Damage Prevented" form which is used by RCC and Economics Branch to compute benefits within the Connecticut River basin will be included in the Master Manual.

15. DROUGHTS

a. General. The Chicopee River watershed lies within the general zone classified as humid, and the average annual precipitation is distributed reasonably well throughout the year. In National Weather Service terminology, a drought is considered to be a period of 14 or more days in which less than 0.1 inch of precipitation falls in a 48-hour period. To the agriculturist, a drought is a lack of soil moisture during the growing season. Hydrologically, a drought is defined as a prolonged period of precipitation deficiency which

seriously affects riverflow as well as surface and ground water supplies. Periods of deficient precipitation and runoff have occurred in the Chicopee River watershed.

b. History. The drought history in the watershed extends back more than 100 years. Several periods of below average precipitation have occurred prior to 1960, although no serious impact was made on the water needs of the area due to the sparse population and lack of industry in the region. The most notable of these occurred in 1880-1883, 1894, 1930, 1941 and 1949.

c. Drought of 1961-1966. The longest and most severe drought in the history of the Connecticut River basin is the one of 1961-1966. During this period, the cumulative precipitation deficiencies (i.e., total amount below normal) at Barre Falls and Ware, Massachusetts were 42.0 and 72.9 inches, respectively, which are 106 and 160 percent of the average annual precipitation. The cumulative runoff deficiencies for water years 1962-1966 at the Ware River at Gibbs Crossing, Quaboag River at West Brimfield and Chicopee River at Indian Orchard were 26.3, 28.9 and 36.8 inches, respectively, which are 130, 130 and 205 percent of the average annual runoff. Rarely is a deficiency of ground water carried over from one growing season to the next in New England, since it is replenished during each spring runoff. However, this condition occurred in the winter of 1964-1965 and resulted in a record low flow runoff at Ware River at Gibbs Crossing, and at the Quaboag River at West Brimfield of 7.4 and 9.4 inches, respectively, in water year 1965. These are 37 and 43 percent, respectively, of the average annual runoff (refer to plate G-30).

CHAPTER IV

COMMUNICATIONS

16. GENERAL

All communications between the project managers and RCC are made via the NED radio network during normal work hours or when NED headquarters are otherwise manned. Whenever the radio network is inoperative, communications are made by telephone. During nonwork hours, reports and regulation instructions are issued via telephone to or from the homes of WCB personnel. In the event of failure of the NED radio network and telephone service, emergency communications will be attempted through the State Police or Civil Defense radio facilities. In addition, radios in the Automatic Hydrologic Radio Reporting Network facilities in the field are tied directly to the RCC computer room serving as a backup system for normal radio communication. Location of the sites are listed in paragraph 19.

17. PRECIPITATION REPORTING NETWORK

Reports of precipitation data from the Chicopee River watershed are used primarily for the purpose of alerting RCC personnel and for providing a basis for appraising the severity of the storm. Collection and reporting of precipitation data from Barre Falls Dam is the responsibility of the project manager who also receives calls from observers in the watershed. Identification and location of these observers is given in the RCC telephone directory which is updated annually.

The Reservoir Control Center periodically reviews network arrangements to insure that an adequate reporting network is maintained. The Northeast River Forecast Center in Bloomfield, Connecticut receives precipitation reports from observers in and near the Chicopee River watershed, which are made available to RCC upon request. In addition, cooperative daily reporting procedures from most Corps dams have been established with the River Forecast Center and have been detailed in separate memos to each project manager.

18. RIVER REPORTING NETWORK

a. General. A network of river stage observation stations, which is part of an overall river reporting system for the Connecticut River basin has been established. This network assists in the execution of the reservoir regulation plan by permitting personnel in RCC and at the dams to obtain river stages at selected key index stations located on tributaries or on the Connecticut River.

b. River Reporting System. The Corps existing reporting system for regulating Barre Falls Dam includes:

USGS gaging station at Barre
Staff gage on the Route 32 highway bridge in Barre Plains
USGS gaging station at the Coldbrook Diversion
USGS gaging station at Indian Orchard
USGS gaging station at Montague City
NED gaging station at York Street pumping station -Springfield
NWS gaging station at Bulkley bridge - Hartford

A brief discussion on each follows:

(1) Ware River at Barre. The USGS gaging station at Barre (plate G-35) measures runoff from the 55 square miles of the upper Ware River watershed controlled by Barre Falls Dam. This gage is located on the left bank about 700 feet downstream from the dam and has been in operation since July 1946. Data from this gage is read remotely from the gate house.

(2) Ware River at Barre Plains. This staff gage, located on the downstream side of the center pier of the Route 32 highway bridge (drainage area - 115 square miles), is an indicator of stage in the low lying area along the Ware River between South Barre and Wheelwright. Observations at this location are requested by RCC from the project manager during high flows.

(3) Ware River at the Coldbrook Diversion. This USGS gage is on the right bank of the Ware River above the diversion structure. Runoff from the upper 96.8 square miles of drainage area of the Ware River watershed is measured and recorded here.

(4) Chicopee River at Indian Orchard. The USGS gaging station at Indian Orchard is located on the left bank of the Chicopee River approximately 7 miles above the mouth. This gage records the runoff from 688 of the 721 square mile watershed. The gage is presently telemark equipped and is also included in the Automatic Hydrologic Radio Reporting Network. The rating table for this location is included on plate G-34.

(5) Connecticut River at Montague City. The USGS gage at Montague City is located on the left bank of the river 75 feet downstream from the NYNH&H Railroad bridge at Montague City and 1,000 feet downstream from the mouth of the Deerfield River. This gage records runoff from 7,865 square miles, is telemark-equipped and also reports via the AHRRN. The rating table for this gage is included on plate G-31.

(6) Connecticut River at Springfield. This gage (plate G-32) is on the left bank at the York Street pumping station, approximately 4,500 feet downstream from Memorial bridge and about 3,000 feet

above the confluence of the Westfield and Connecticut Rivers. During flood periods, it is used to measure stages associated with runoff from a drainage area of 9,587 square miles, including the Westfield River watershed. Data from the gage is automatically transmittted via the AHRRN.

(7) Connecticut River at Hartford, Connecticut. The gage (plate G-31) on the Connecticut River is located on Bulkley bridge in Hartford and is in a natural storage reach, resulting in a hysteresis curve for the stage-discharge relationship. This station has an area of 10,428 square miles, is telemark-equipped and reports via AHRRN to the Reservoir Control Center.

C. Future Plans

Paragraph 19 and 20 discuss the collecton of hydrologic data by means of a radio reporting network. When and if the GOES system becomes "operational", RCC will consider locating DCP's at the Route 32 bridge in Barre Plains and also at the USGS gaging station on the Ware River at Gibbs Crossing. This gage has an area of 199 square miles and is located in Ware approximately 25 river miles downstream of Barre Falls Dam.

19. AUTOMATIC HYDROLOGIC RADIO REPORTING NETWORK

The effective regulation of flood control projects in New England, consisting of 35 flood control dams and four hurricane barriers, requires reliable and rapid method of collection and coordinating hydrologic data by the Reservoir Control Center. In January 1970, the installation of an Automatic Hydrologic Radio Reporting Network (AHRRN) was completed. Radio gaging stations have been established at the following locations in the Connecticut River basin:

Connecticut River at Wells River, Vermont
White River at West Hartford, Vermont
Connecticut River at West Lebanon, New Hampshire
Connecticut River at North Walpole, New Hampshire
Ashuelot River at Keene, New Hampshire

Deerfield River at West Deerfield, Massachusetts
Connecticut River at Montague City, Massachusetts
Chicopee River at Indian Orchard, Massachusetts
Westfield River at Westfield, Massachusetts

Connecticut River at Springfield, Massachusetts
Mad River Lake at Winchester, Connecticut
Farmington River at Unionville, Connecticut
Farmington River at Rainbow, Connecticut
Connecticut River at Hartford, Connecticut

Details of the computer controlled radio hydrologic reporting network are covered in a report prepared by RCC in August 1976, entitled: "Flood Control Automatic Hydrologic Radio Reporting Network." Plate G-47 shows a computer printout of a typical interrogation.

20. DATA COLLECTION BY SATELLITE

In June 1972, NED entered into a contract with the National Aeronautic and Space Administration (NASA) for an experiment to study the feasibility of using the Earth Resources Technology Satellite (ERTS, later referred to as LANDSAT) for collecting hydrologic data from about 20 stations in New England. Many of these stations were USGS gages. A major objective of this experimental program was to compare the cost, reliability and operational effectiveness of the LANDSAT data collection with the existing NED (AHRRN) radio network. A final report, issued in March 1975, stated the concept was economically feasible and operationally reliable; however, more frequent reporting times would be required for an operational system. In 1975 as an outgrowth of this work, NED installed a ground receive station consisting of a 15-foot parabolic antenna and satellite tracking equipment.

In August 1977, NED investigated the capability of receiving hydrologic data via GOES, a geostationary operational satellite operated by NOAA, employing NED's existing 15 foot downlink. Approval was obtained from OCE in September 1977 to procure a GOES receive station and to purchase data collection platforms. Conversion of the downlink was performed in 1978 and the system is now capable of receiving data from LANDSAT or GOES and contains dual minicomputers to accomodate the GOES data collection. Plans are underway for purchase of 50 GOES DCP's during FY 1979, pending OCE approval.

21. REPORTS

a. Weekly Reports. The project manager makes a routine report via radio (or telephone) to RCC each Friday morning. This report insures continuous contact between field personnel and RCC, and also serves as a check on the communications network. The report includes the preceding 24-hour precipitation, current weather conditions at index stations and other miscellaneous data. A sample of a completed Friday morning report is shown on plate G-48.

b. Alerting Reports. An alerting report is promptly made and should include pertinent data that is readily obtained together with a general appraisal of local conditions although data from all precipitation or index gaging stations may not be available. Whenever any of the following conditions occur, the manager will immediately notify RCC:

(1) Precipitation. Occurrence of 1-inch precipitation or other amount as indicated by RCC during any 24-hour period at Barre Falls Dam.

(2) Reservoir Stages. A reservoir stage of 776 feet msl and rising during the nonfreezing season or 780 feet and rising during the freezing season at Barre Falls Dam.

c. Supplemental Reports. Supplemental radio (or telephone) reports are made to RCC by the manager either following instructions from RCC or if it appears that flood conditions might develop in the watershed as the result of melting snow, ice jams, dam failures or heavy localized rainfall. The time and frequency of these reports are dependent upon the severity of conditions and specific instructions from RCC. Plate G-49 shows a typical reporting log, indicating the data to be included in reports by the project manager during flood periods. The following information is included in the flood report to RCC.

(1) Precipitation at Dam. The total amount of precipitation which has fallen up to the time of reporting and several intermediate amounts with times of observation, as indicated by RCC.

(2) Reservoir Stage. The pool stage at time of reporting and several previous readings with corresponding times to determine the rate of rise and define the inflow hydrograph. Accurate readings of stage and time are essential to facilitate computation of inflow (see plates G-50 through G-52).

(3) Gate Positions. Gate openings and discharges at time of reporting and at beginning of storm. Any gate changes since preceding report should be included with corresponding stage and discharge.

(4) Precipitation Reports from Observers. Rainfall data received from watershed observers.

(5) River Stages. Ware and Chicopee River stages with times of observations from gages at Coldbrook Diversion, Barre Plains, and Indian Orchard as requested by RCC.

(6) Snow Cover. General snow cover which may affect runoff conditions throughout the basin.

(7) Miscellaneous Data. Any other information which might be pertinent such as temperature, etc.

d. Special Reports. A special report is submitted by the manager to RCC whenever unusual circumstances occur during a flood or as requested by RCC. The report may be written in longhand and should describe the subjects outlined below if appropriate.

(1) Observations at Dam. The manager makes general observations of conditions occurring at the outlet works as listed on the following page. The observations are entered in the log book at the dam. If possible, photographs are taken of any unusual conditions, noting data, time, reservoir gage heights and position of the gates. Observations which should be reported to RCC are:

(a) Extent and action of eddies, waves or whirlpools in the vicinity of the conduit intakes and portals.

(b) Extent and action of turbulence or eddies downstream of the spillway and outlet works.

(c) Effect on flow through the gates due to an accumulation of ice or debris at the intake.

(d) Pool elevation and position of gates where gate vibration or whirlpools develop.

(e) Any seepage - noting time, pool stage, and color of discharge. Embankment sloughing which may appear at the downstream sides of the dam or dikes should also be reported.

(f) Any other unusual hydraulic phenomena that may occur.

Observations at Conant Brook will be made by the Westville Lake project manager at the request of RCC.

(2) Observations at Downstream Control Points. During periods of reservoir impoundments, particularly while emptying the reservoir, reconnaissance of downstream conditions is made by either the project manager or his assistant upon specific authorization from RCC. This is done to obtain further flood data in the downstream damage areas or index points along the Ware, Chicopee or Connecticut Rivers.

e. Snow Survey Reports. Snow courses have been established at selected locations within the upper watershed (table G-5). Weekly surveys are made by the managers during winter and early spring to determine the depth of snow and equivalent water content. Dates for surveys are determined each year by RCC so as to correspond with monthly bulletins of the U.S. Geological Survey and supplemental data from State agencies and power companies. The reports contain the name of the station, snow depth and water equivalent. Average, maximum and minimum water equivalent of snow cover in the Chicopee River watershed are shown on plate G-28.

f. Northeast River Forecast Center Reports. The project manager at Barre Falls Dam will make a daily telephone call at 0815 hours to the Northeast River Forecast Center (NERFC) to report hydrologic and climatologic conditions at the dam. The following parameters will be reported on a daily basis:

Dam	Depth of new snow
Date	Total depth of snow
Time of observation	Temperature - max. preceding 24 hours
Precipitation (24 hours)	Temperature - min. preceding 24 hours
Present weather	Temperature - current

The above data is used to develop a Chicopee River headwater statement. The statement, transmitted by NERFC to RCC twice weekly, gives the amount of rainfall in six hours required to produce runoff varying from .25 to 5 inches into Corps reservoirs.

22. SPECIAL ADVISORIES

In accordance with regulations set forth in EM 550-1-1, "Domestic Emergency Operations", and the "Guidance Memorandum, Reservoir Control Center", special advisories from RCC on flood potential and progress of all threatening storms are submitted to the Division Engineer and to the Chief of Engineering and Operations Divisions. Flood reports are also prepared for OCE by RCC.

23. MAINTENANCE OF LOG

All reports, instructions, records of unusual circumstances at the dam, and information pertinent to regulation of the reservoir are entered in the logs (plate G-49). Logs are maintained by the project managers and Reservoir Control Center.

24. GATE OPERATION RECORD

All gate operations are carefully noted on NED Form 90 (plate G-53) and submitted bimonthly to RCC. All operations are noted regardless of the duration of the change in gate position. The report includes data and time of day, reservoir stage, outflow, precipitation, gate opening, tailwater reading and remarks column. RCC personnel utilize the Form 90's in the preparation of the monthly charts of reservoir regulation, which serve as permanent records of reservoir regulation. Form 90's are also utilized in the preparation of yearly reservoir regulation exhibits for the RCC Annual Report, which is forwarded to OCE, NED personnel, other agencies, and the public.

CHAPTER V

HYDROLOGIC FORECASTS

25. NATIONAL WEATHER SERVICE

a. Weather Forecasts. The National Weather Service in Boston, Massachusetts is responsible for issuing daily weather forecasts for public dissemination through the news media. These reports are received at RCC approximately four times each day on the Weather Service teletype loop.

b. Precipitation Forecasts. In addition to the normal weather forecasts, quantitative precipitation forecasts are received daily by RCC. Supplemental weather information and forecasts prior to or during floods are made available upon request.

c. River Forecasts. The Northeast River Forecast Center at Bloomfield, Connecticut is responsible for preparing and disseminating flood forecasts for the Connecticut River and some of the principal tributaries. Flood forecasts in the Connecticut River basin are listed for the following locations:

Connecticut River at N. Stratford, New Hampshire
Connecticut River at Dalton, New Hampshire
Connecticut River at Wells River, Vermont
Connecticut River at White River Jct, Vermont
Connecticut River at N. Walpole, Vermont
Connecticut River at Montague City, Massachusetts
Connecticut River at Thompsonville, Connecticut
Connecticut River at Hartford, Connecticut
Connecticut River at Bodkin Rock, Connecticut
Passumpsic River at Passumpsic, New Hampshire
Ammonoosuc River at Bath, New Hampshire
White River at West Hartford, Vermont
Chicopee River at Indian Orchard, Massachusetts
Farmington River at Rainbow, Connecticut

26. CORPS OF ENGINEERS

a. Chicopee River Forecasts. During flood periods in the Chicopee River watershed, Barre Falls Dam is principally operated to provide protection to communities downstream on the Ware River. Experience at Barre Falls has shown that regulating for a stage of 2.5 feet at the Barre Plains gage (peak travel time from the dam - 5 to 7 hours) during the growing season and 5.5 feet during the nongrowing season will adequately protect these communities.

While regulating Barre Falls when the Coldbrook intake is diverting, consideration should be given to the effects these diversions have on releases from Barre Falls. Peak flow travel time from Barre Falls to Coldbrook is 3 to 4 hours.

During high flows, the travel time of releases from Barre Falls to the Chicopee River at Indian Orchard is about 21 hours. As a result of this extensive travel time and the large intervening drainage area between the dam and Indian Orchard, the effects of regulation at Barre Falls will usually be minimal along the Chicopee River.

Therefore, considering that releases from Barre Falls are governed by stages at Barre Plains and that they have little effect on the Chicopee River, it has not been considered necessary to develop specific flood forecasting procedures for the Chicopee River watershed. In addition, RCC continually receives weather, quantitative precipitation and flood forecasts from the National Weather Service and data from the automatic hydrologic radio network and the other 25 manned dams.

b. Future Flood Forecasts. In December 1971, the Reservoir Control Center requested the Hydrologic Engineering Center to develop a flood forecasting technique for the Merrimack River basin based on "real time" data collected from the Automatic Radio Reporting Network, flood control dams and other sources. This technique has been developed for in-house use and further refinement, and may be utilized in developing forecast procedures for the Connecticut River basin.

CHAPTER VII

HYDROLOGIC EQUIPMENT

40. PRECIPITATION GAGE

A standard weighing and recording NWS precipitation gage has been installed at Barre Falls Dam and serves as a supplement to other NWS rainfall stations within or in the vicinity of the Chicopee River watershed.

The project manager or his assistant should check this gage daily to determine if it is operating properly and also to record any precipitation occurrence in the last 24 hours.

41. RESERVOIR STAGE RECORDER

The automatic float-operated water level recorder at Barre Falls traces the water level in the reservoir at all times. Recording instruments should be checked each morning to assure the clock is keeping correct time and the pen is tracing properly. Any discrepancies in the record as evidenced by the pen time or gage heights should be noted on the chart and the instrument reset. During periods of reservoir storage, the outside tile or staff gage should be read to check tape readings and/or chart records. Should the recorder become inoperable, the USGS should be notified and arrangements made to repair the instrument; RCC should also be notified.

The chart record should be changed the first working day of each month at Barre Falls and the following information noted in ink at the beginning and end of each chart:

Outside (tile) gage reading
Pen gage height reading
Watch time
Pen time
Date and name of dam

Conant Brook dam is equipped with a bubble gage recorder which continuously measures and records the pool levels. This gage is housed in a concrete structure on top of the dam. The Project Manager of Westville Lake checks this recorder weekly and replaces the pool chart monthly. Pool charts from Conant Brook are sent to RCC for use in preparing monthly pool charts and then returned to Westville Dam where they are kept on file.

42. TAILWATER GAGING STATIONS

A remote recorder at the USGS gage immediately downstream of Barre Falls at Barre, transmits river stages directly to the dam. This gage is equipped with a digital-type water stage recorder and is operated and maintained under a cooperative stream gaging program with the USGS and hence provides a continuous official record of releases from the project. It is essential that this gage be checked frequently to assure proper operation. If inspection indicates a need for repair, the USGS should be notified immediately and arrangements made to have the equipment repaired.

43. TELEPHONE TRANSMITTER (TELEMARK)

The telephone transmitter on the Chicopee River at Indian Orchard is used for regulation in the Chicopee River watershed. The project manager of Barre Falls calls the gage at Indian Orchard as part of the normal weekly report. During failure of communications, the Barre Falls project manager should also consider stages at the Indian Orchard gage. Should the telemark become inoperable during the weekly check, the project manager should visit the gage. If the trouble cannot be determined the telephone company should be requested to check their circuits in the presence of the project manager. If the telemark still is not functioning by this time, the USGS should be notified. Batteries for equipment at these gaging stations will be furnished and installed by the USGS.

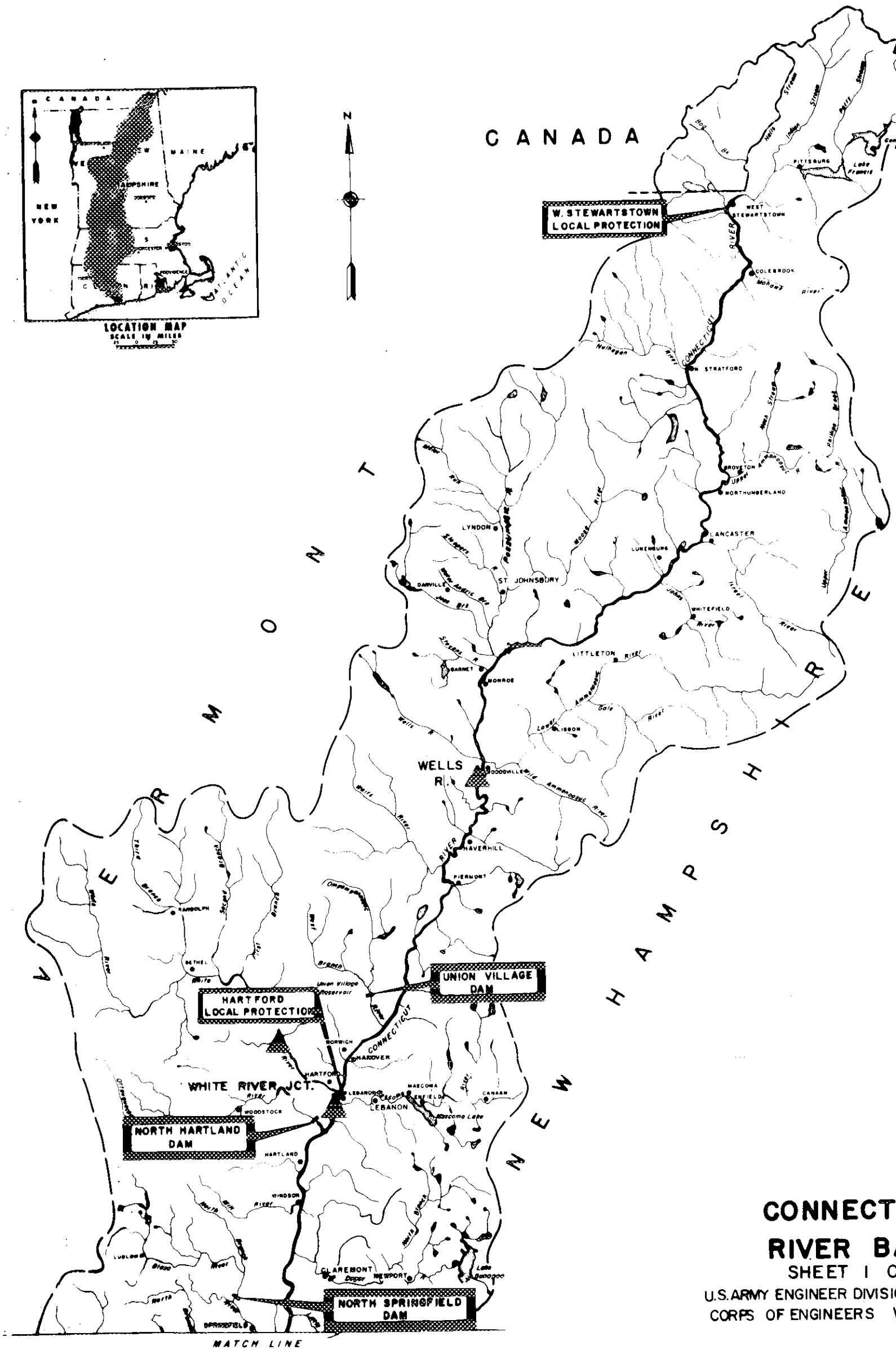
44. SNOW SAMPLING SET

A snow sampling set has been assigned to the project manager at Barre Falls. Snow surveys in the Chicopee River watershed will be carried out by the project managers and their assistants from Barre Falls and East Brimfield Lake. Procedures for obtaining snow survey data should follow instructions set forth in "Snow Sampling Guide, Department of Agriculture, Handbook 1960". If given proper care, the only maintenance required would be occasional replacement of worn out cutterheads.

Snow surveys will normally be conducted from 15 January to 15 April or as long as RCC considers necessary. Prior preparation by the project manager should include inspection of the snow survey equipment and reconnaissance of the snow survey courses.

Full snow surveys will generally take place every other week to coincide with surveys by the Massachusetts Water Resources Commission, New Hampshire Water Resources Board and the New England Power Company. On alternate weeks, index snow surveys involving selected snow courses will be taken, to determine general conditions in the watershed.

LOCATION MAP
SCALE IN MILES



CONNECTICUT RIVER BASIN

SHEET 1 OF 2

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

SCALE IN MILES

JULY 1977

PLATE G-1

MATCH LINE

WESTON LOCAL PROT.

CHARLESTOWN LOCAL PROT.

BALL MOUNTAIN DAM

TOWNSHEND DAM

SURRY MOUNTAIN DAM

OTTER BROOK DAM

TULLY DAM

BIRCH HILL DAM

GARDNER LOCAL PROT.

KNIGHTVILLE DAM

BARRE FALLS DAM

NORTHAMPTON LOCAL PROT.

LITTLEVILLE DAM

HOLYOKE LOCAL PROT.

CHICOPEE LOCAL PROT.

WARE LOCAL PROT.

CHICOPEE FALLS LOCAL PROT

RIVERDALE LOCAL PROT.

THREE RIVERS LOCAL PROT.

WEST WARREN LOCAL PROT.

SPRINGDALE LOCAL PROT.

SPRINGFIELD LOCAL PROT.

CONANT BROOK DAM

COLEBROOK RIVER DAM

MAD RIVER DAM

WEST SPRINGFIELD LOCAL PROT

SUCKER BROOK DAM

HARTFORD LOCAL PROT.

EAST HARTFORD LOCAL PROT.

COMPLETED PROJECT

* SMALL FLOOD CONTROL PROJECTS NOT SPECIFICALLY AUTHORIZED BY CONGRESS

▲ RADIO GAGING STATION

CONNECTICUT RIVER BASIN

SHEET 2 OF 2

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

SCALE IN MILES

JULY 1977

PLATE G-2

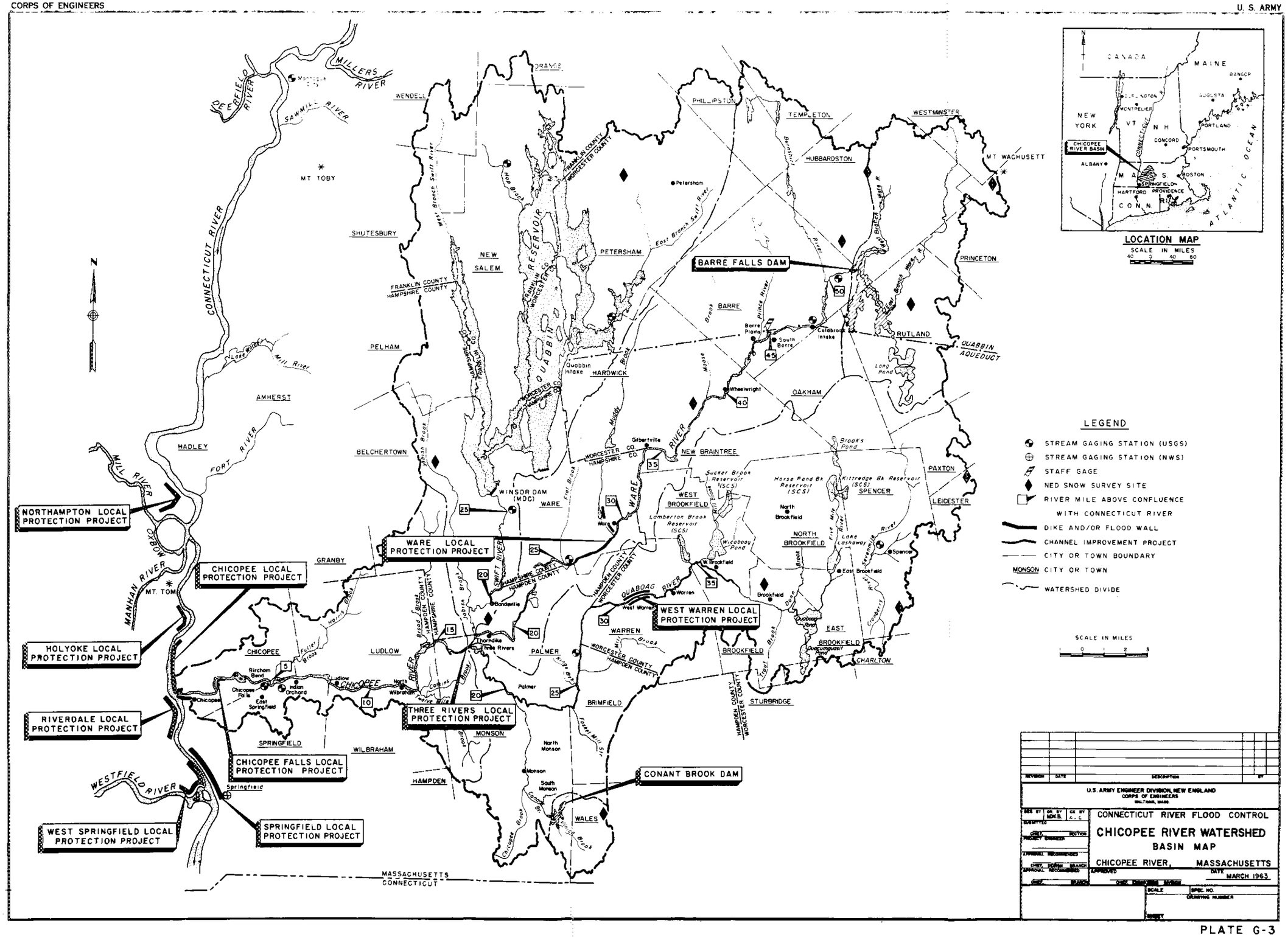
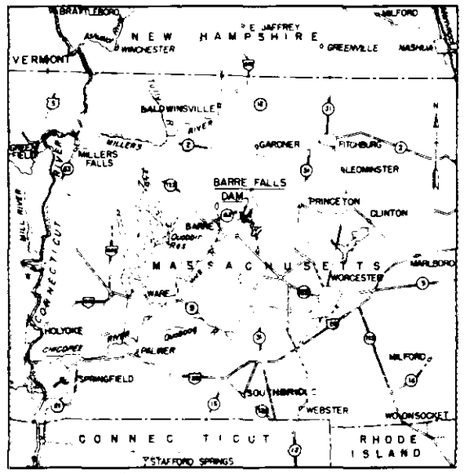
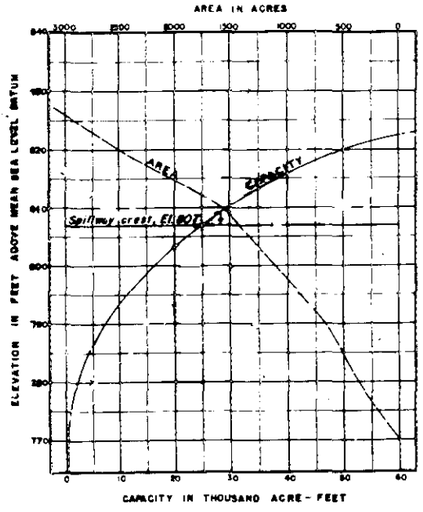

LOCATION MAP
SCALE IN MILES
CANADA
MAINE
NEW YORK
VT
N H
MASS
CONN
RI
CHICOPEE RIVER BASIN
ATLANTIC OCEAN
LEGEND
STREAM GAGING STATION (USGS)
STREAM GAGING STATION (NWS)
STAFF GAGE
NED SNOW SURVEY SITE
RIVER MILE ABOVE CONFLUENCE WITH CONNECTICUT RIVER
DIKE AND/OR FLOOD WALL
CHANNEL IMPROVEMENT PROJECT
CITY OR TOWN BOUNDARY
MONSON CITY OR TOWN
WATERSHED DIVIDE
SCALE IN MILES
NORTHAMPTON LOCAL PROTECTION PROJECT
CHICOPEE LOCAL PROTECTION PROJECT
HOLYOKE LOCAL PROTECTION PROJECT
RIVERDALE LOCAL PROTECTION PROJECT
CHICOPEE FALLS LOCAL PROTECTION PROJECT
WEST SPRINGFIELD LOCAL PROTECTION PROJECT
SPRINGFIELD LOCAL PROTECTION PROJECT
WARE LOCAL PROTECTION PROJECT
THREE RIVERS LOCAL PROTECTION PROJECT
WEST WARREN LOCAL PROTECTION PROJECT
CONANT BROOK DAM
BARRE FALLS DAM
QUABBIN RESERVOIR
QUABBIN AQUEDUCT
CONNECTICUT RIVER
MILLERS RIVER
DEERFIELD RIVER
SAWMILL RIVER
MT TOBY
MT. TOM
MT WACHUSETT
MILL RIVER
FORT RIVER
MANHAN RIVER
OXBOW
WESTFIELD RIVER
QUABOAG RIVER
WARE RIVER
SWIFT RIVER
CHICOPEE RIVER
WINSOR DAM (MDC)
MASSACHUSETTS
CONNECTICUT
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER WATERSHED
BASIN MAP
CHICOPEE RIVER, MASSACHUSETTS
MARCH 1963

PLATE G-3



VICINITY MAP

SCALE 1 IN = 2 MI

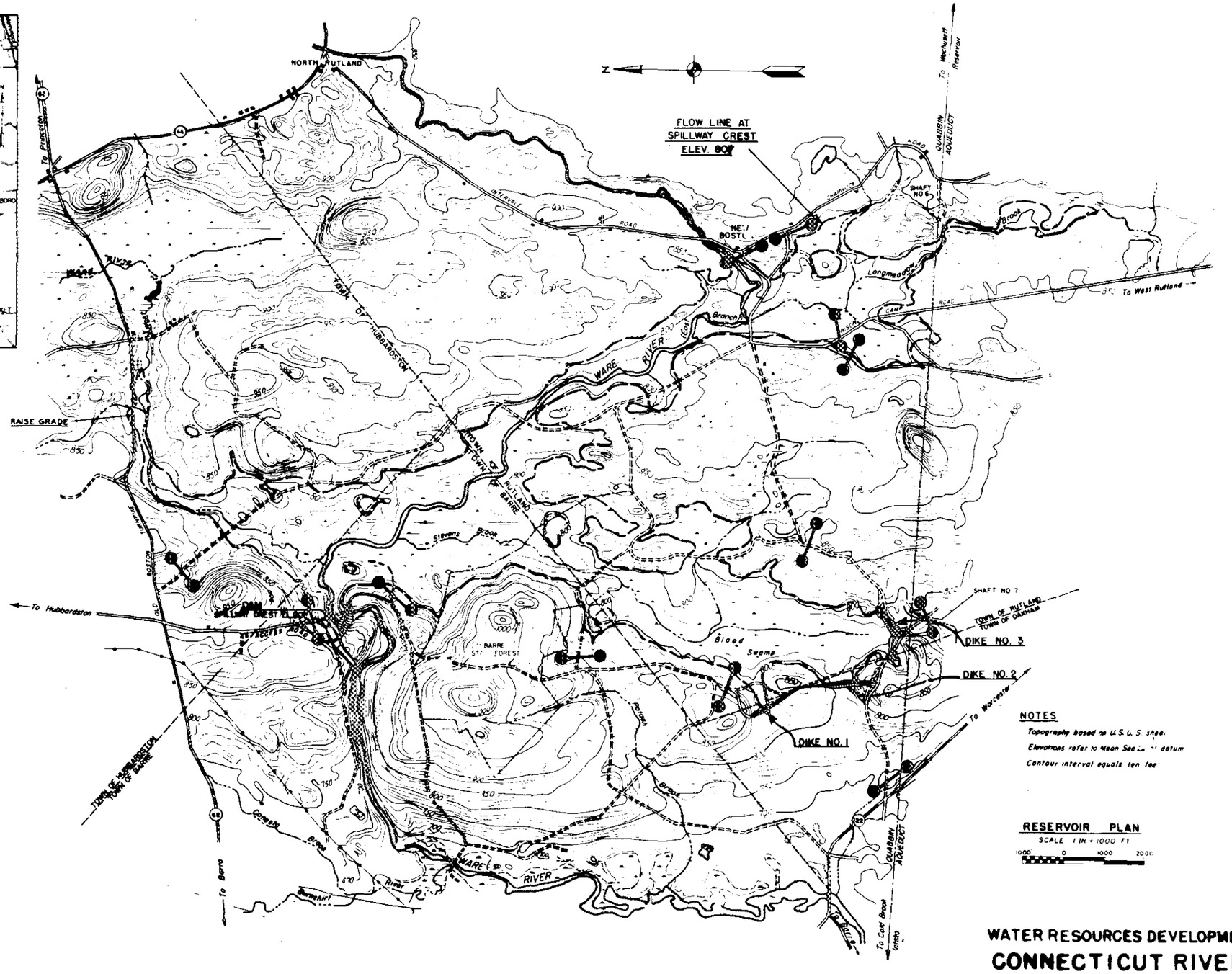


AREA AND CAPACITY CURVES

DRAINAGE AREA 57 SQ. MI.

LEGEND

- Existing numbered routes
- Existing paved highways
- Existing gravel roads
- Proposed highway relocation or improvement
- Reservoir flowage area at spillway crest El 807
- Road Barricade



NOTES

Topography based on U.S.G.S. sheets

Elevations refer to Mean Sea Level datum

Contour interval equals ten feet

RESERVOIR PLAN

SCALE 1 IN = 1000 FT

1000 0 1000 2000

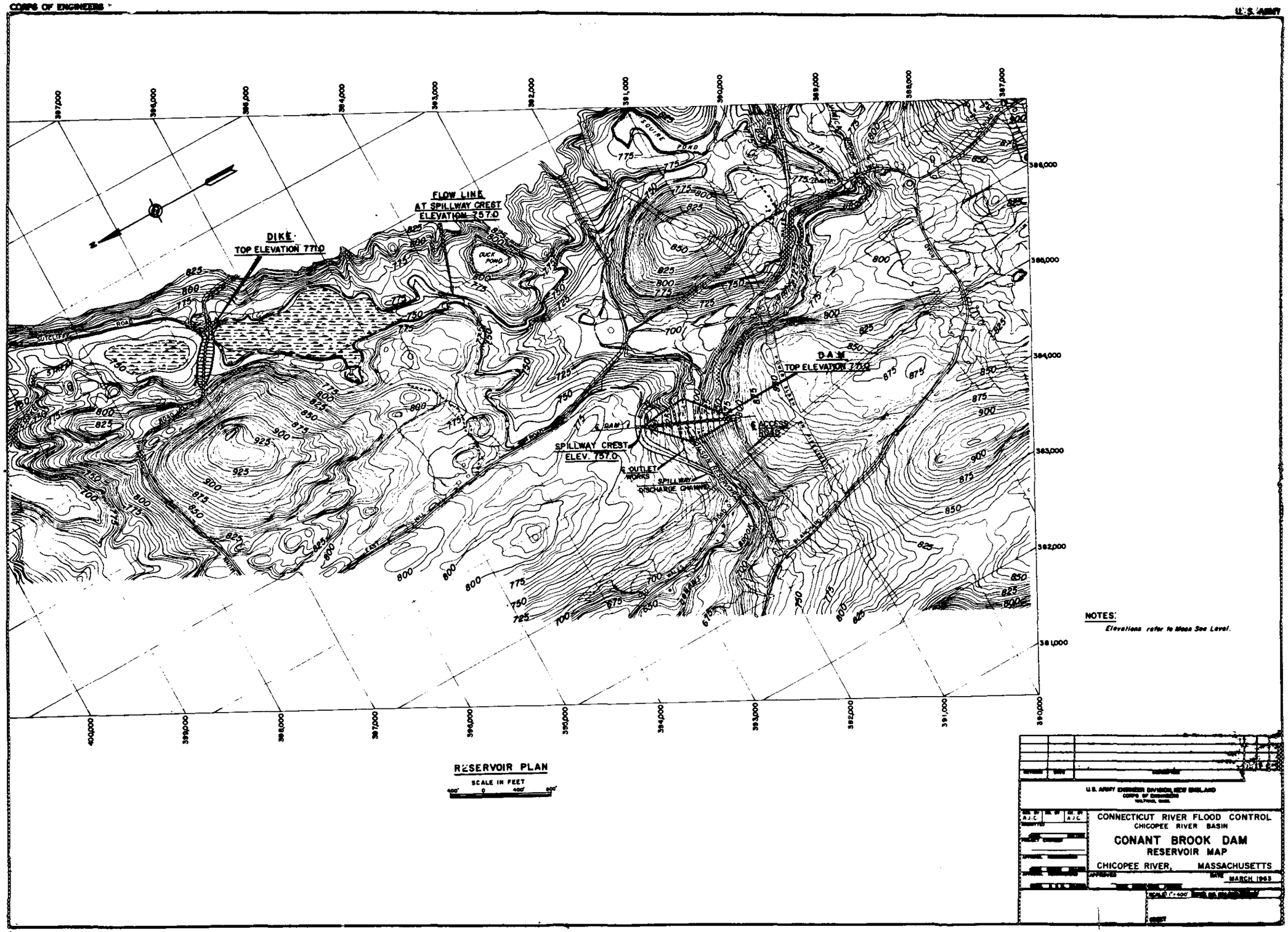
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
BARRE FALLS DAM

RESERVOIR MAP

NEW ENGLAND DIVISION, WALTHAM, MA.
AUGUST 1978

PLATE G-4



NOTES:

Elevations refer to Mean Sea Level.

RESERVOIR PLAN

SCALE IN FEET

400' 0 400' 800'

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN

CONANT BROOK DAM
RESERVOIR MAP

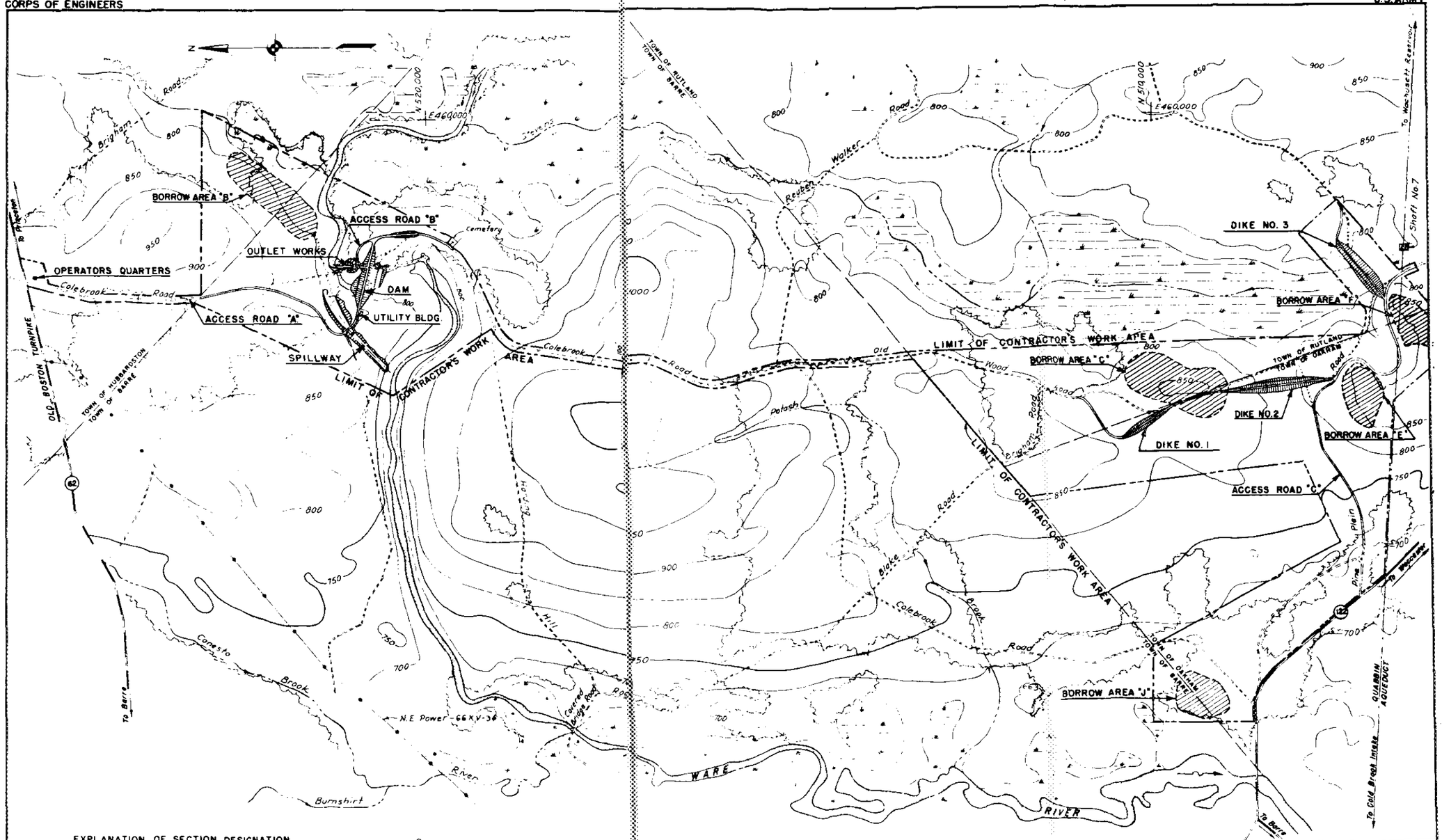
CHICOPEE RIVER, MASSACHUSETTS

DATE MARCH 1963

PLATE G-5

CORPS OF ENGINEERS

U.S. ARMY



EXPLANATION OF SECTION DESIGNATION

A section shown on the same sheet on which it is cut is designated by letter only

A section shown on a sheet other than that on which it is cut is designated by a fraction. The numerator of the fraction is the section reference and the denominators are the sheet numbers on which the section is either cut or shown

EXAMPLE

Section A is cut on Sheet No 3 and the section is actually shown on Sheet No 4. On Sheet No 3 the section designation is $\frac{A}{4}$ and on Sheet No 4 is $\frac{A}{3}$

LEGEND

- State Highways
- Existing gravel or dirt roads.
- Limit of contractors work area.
- Limits of wooded area
- Limits of borrow areas

NOTES

Contour interval, 50 feet.
Elevations refer to Mean Sea Level Datum.
Grid system based on Mass State Plane Coordinates.
Flow line at Spillway Crest E. 8970 M.S.L.

SCALE 1" = 500'

500' 0 500' 1000'

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION BOSTON MASS

DES BY WKU | DR BY CMA | CK BY

CONNECTICUT RIVER FLOOD CONTROL
BARRE FALLS DAM
GENERAL PLAN
WARE RIVER MASSACHUSETTS

APPROVED | DATE FEB. 1956

SCALE 1" = 500' | SPEC NO

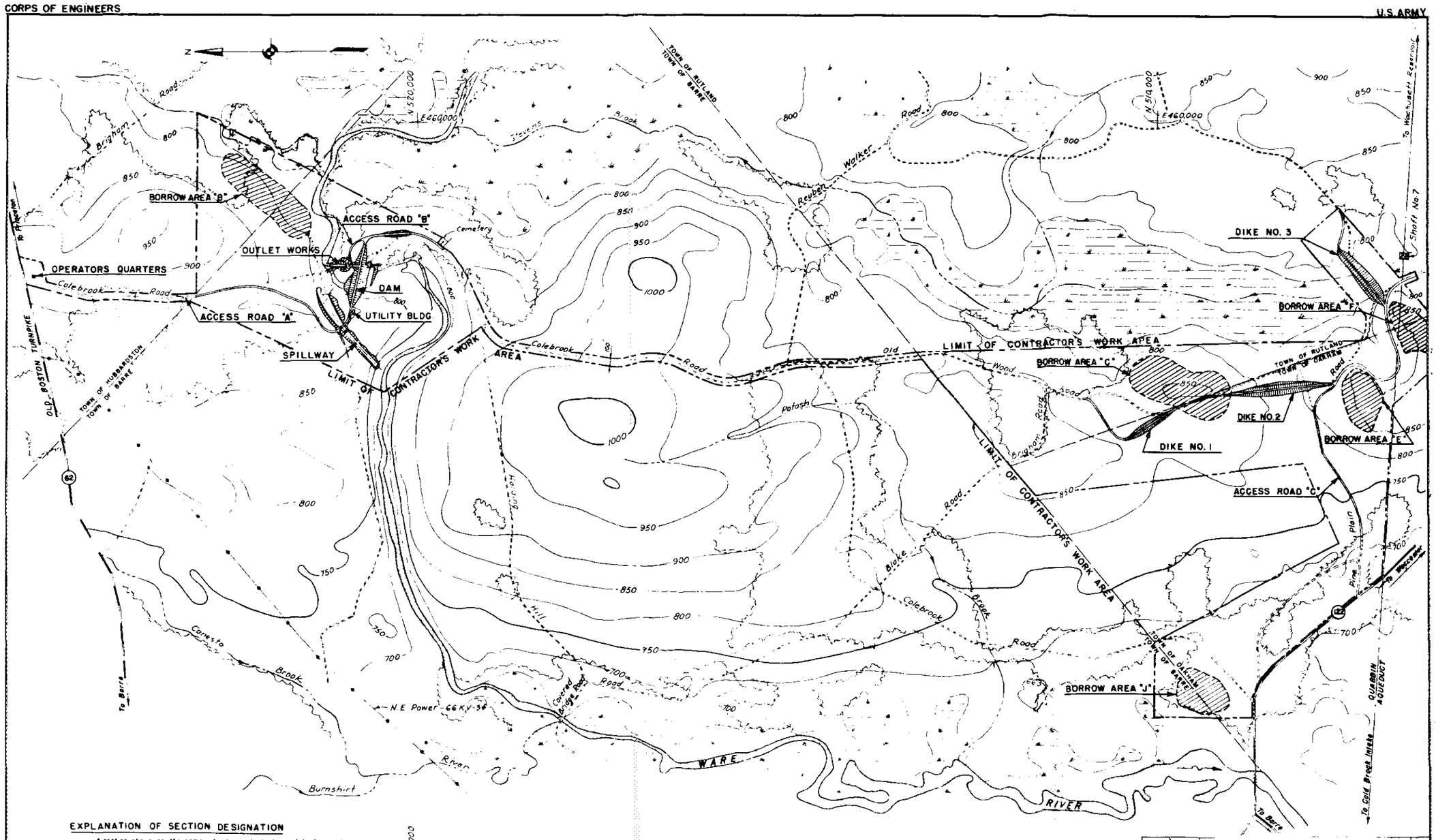
DRAWING NUMBER CT-1-3074

SHEET 2 OF 78

PLATE G-6

CORPS OF ENGINEERS

U.S. ARMY



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EXAMPLE

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LEGEND

- State Highways
- Existing gravel or dirt roads
- Limit of contractor's work area
- Limits of wooded area
- Limits of borrow areas

NOTES

Contour interval, 50 feet.

Elevations refer to Mean Sea Level Datum.

Grid system based on Mass State Plane Coordinates.

Flow line at Spillway Crest E. 800.0 M.S.L.

SCALE 1" = 500'

500' 0 500' 1000'

DIVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION BOSTON MASS

DES BY WKG | DR BY LMA | CK BY

CONNECTICUT RIVER FLOOD CONTROL
BARRE FALLS DAM
GENERAL PLAN
WARE RIVER MASSACHUSETTS

APPROVED ... DATE FEB. 1956

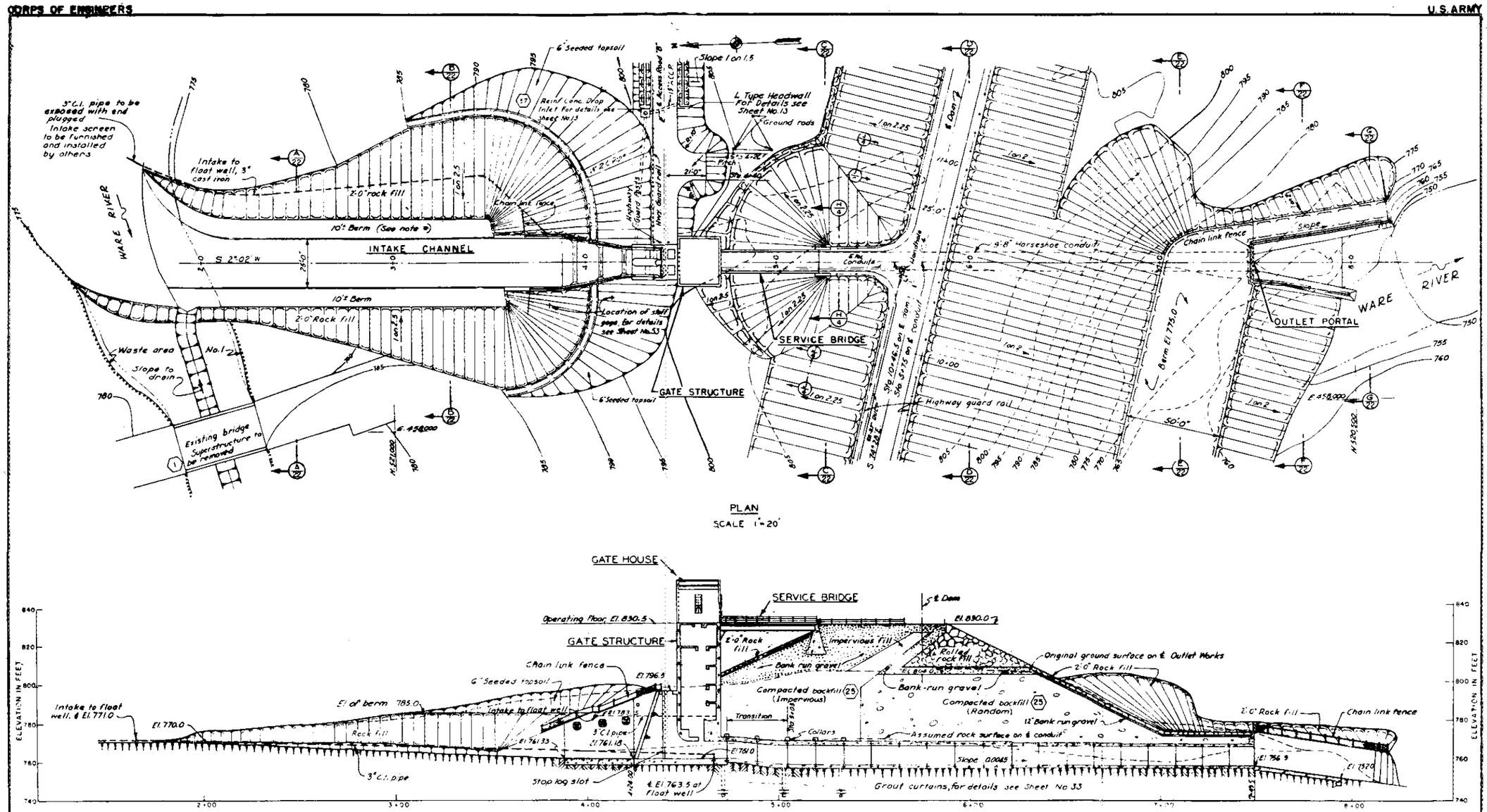
SCALE 1" = 500' SPEC NO

DRAWING NUMBER CT-1-3074

SHEET 2 OF 78

PLATE G-6

CORPS OF ENGINEERS U.S. ARMY



NOTES
Contour interval, 5 feet
Elevations refer to Mean Sea level Datum.
Grid system based on Mass State Plane Coordinates
* Width of rock berms to be varied in the field to obtain regularity of earth slopes. Minimum width of berm, 5'.

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION BOSTON, MASS

CONNECTICUT RIVER FLOOD CONTROL
BARRE FALLS DAM
OUTLET WORKS
PLAN AND PROFILE
WARE RIVER MASSACHUSETTS

DATE FEB. 1956
SCALE 1"=20'-0"
DRAWING NUMBER CT-1-3093

(REVISED 25 APRIL 1956)

PLATE G-7

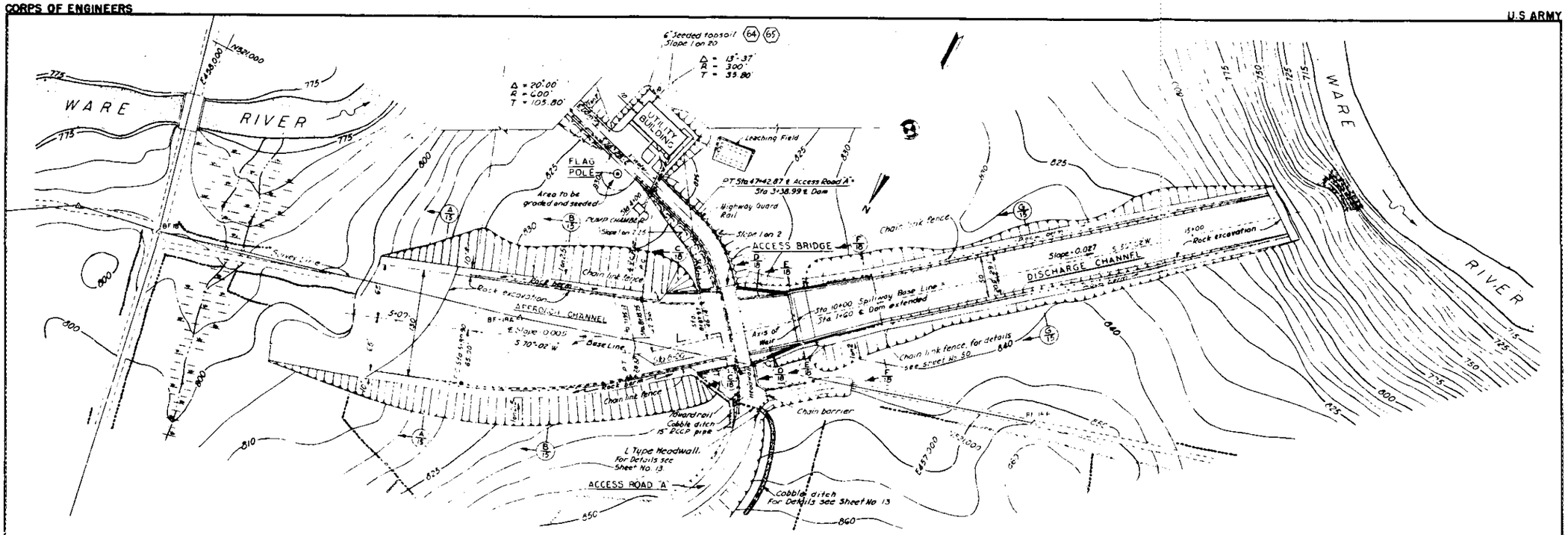
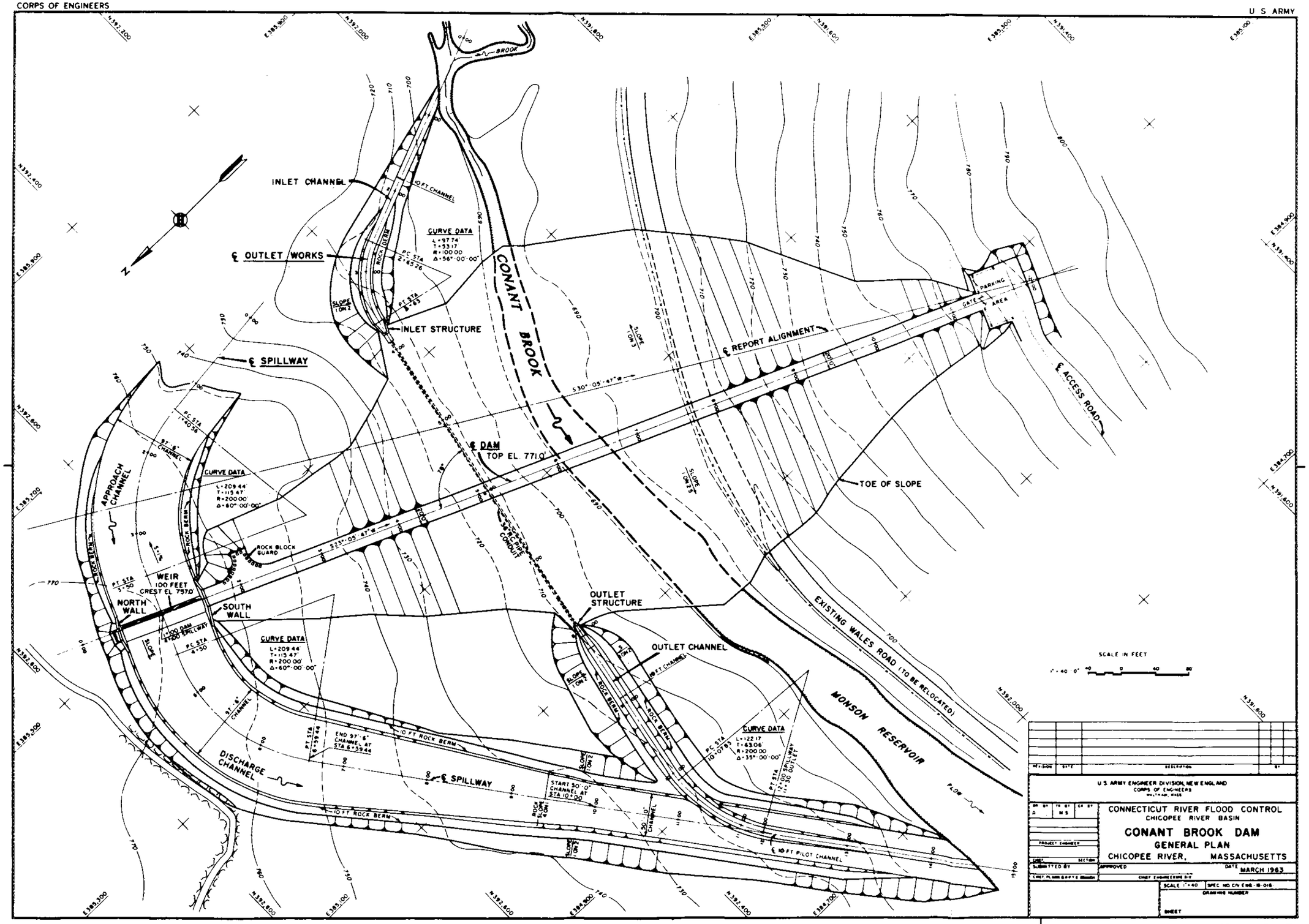

WARE RIVER
UTILITY BUILDING
FLAG POLE
Leaching Field
Area to be graded and seeded
PUMP CHAMBER
Highway Guard Rail
ACCESS BRIDGE
Chain link fence
Rock excavation
APPROACH CHANNEL
DISCHARGE CHANNEL
Slope 0.027
Axis of Weir
Chain link fence, for details see Sheet No. 50
Chain barrier
Cobble ditch 15" RCCP pipe
L Type Headwall. For Details see Sheet No. 13
ACCESS ROAD "A"
Cobble ditch For Details see Sheet No. 13
PLAN
ACCESS BRIDGE
Original ground surface along ℄ channel
Assumed rock surface
Grade at edge of channel
Grade at ℄ channel
APPROACH CHANNEL
DISCHARGE CHANNEL
Assumed rock surface along ℄ channel
Original ground surface along ℄ channel
Assumed rock surface
Axis of Weir
WARE RIVER
ELEVATION IN FEET
PROFILE ALONG ℄ SPILLWAY CHANNEL
NOTES
Contour interval, 5 feet.
Elevations refer to Mean Sea Level Datum.
Grid system based on Mass. State Plane Coordinates.
SCALE 1" = 50'
REVISION DATE DESCRIPTION BY
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION BOSTON, MASS.
CONNECTICUT RIVER FLOOD CONTROL
BARRE FALLS DAM
SPILLWAY
PLAN AND PROFILE
WARE RIVER MASSACHUSETTS
DATE FEB. 1956
SCALE AS SHOWN
DRAWING NUMBER CT-1-3086

PLATE G-8

CORPS OF ENGINEERS

U S ARMY



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN

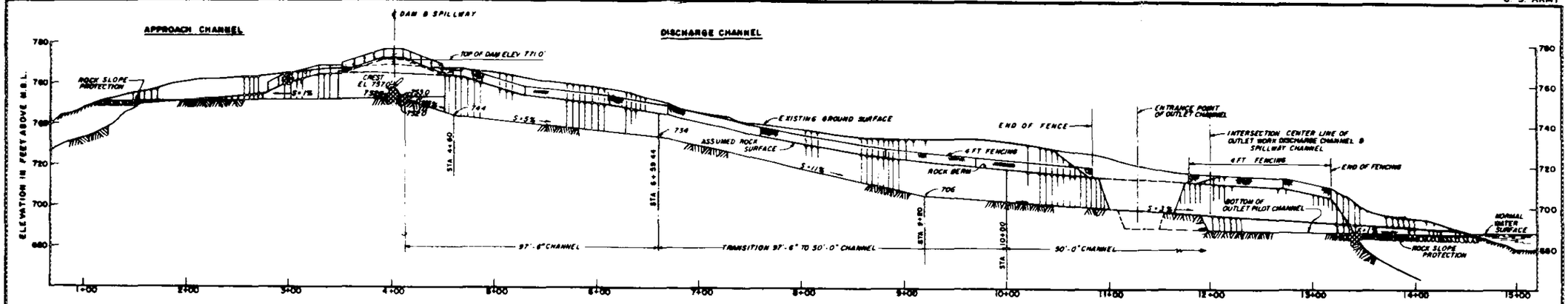
CONANT BROOK DAM
GENERAL PLAN
CHICOPEE RIVER, MASSACHUSETTS

SUBMITTED BY
APPROVED
DATE MARCH 1963
SCALE 1"=40'
SPEC NO CIV ENG-18-016
DRAWING NUMBER
SHEET

PLATE G-9

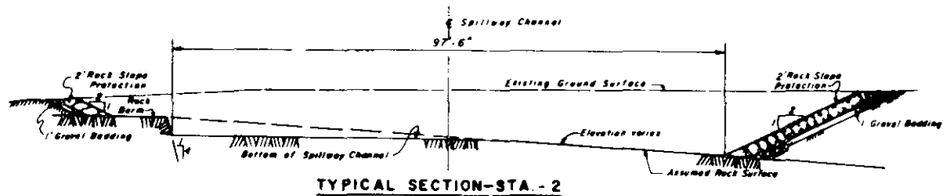
CORPS OF ENGINEERS

U. S. ARMY



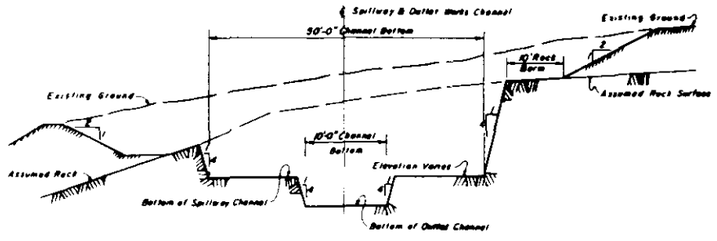
PROFILE ON ℄ OF SPILLWAY CHANNEL

SCALE HORIZONTAL 1" = 40' VERTICAL 1" = 20'



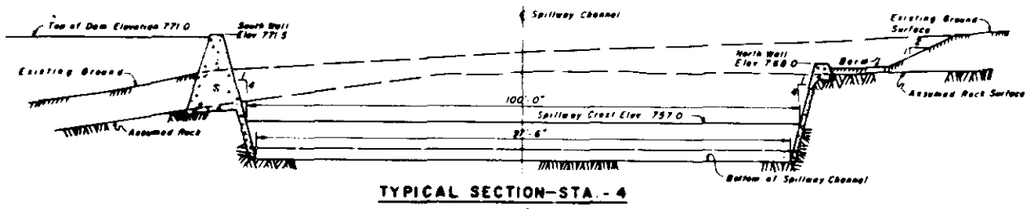
TYPICAL SECTION-STA. - 2

SCALE 1" = 10'



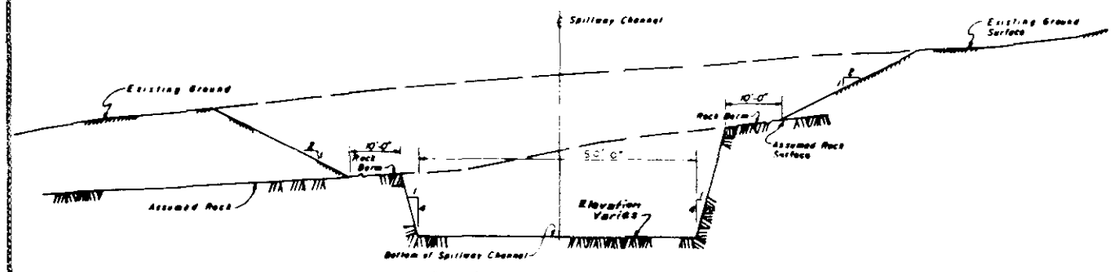
TYPICAL SECTION-STA. - 13

SCALE 1" = 10'



TYPICAL SECTION-STA. - 4

SCALE 1" = 10'



TYPICAL SECTION-STA. - 10

SCALE 1" = 10'

NOTE:

Outlet Pilot Channel between Station 11+30± and Station 14+80±

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

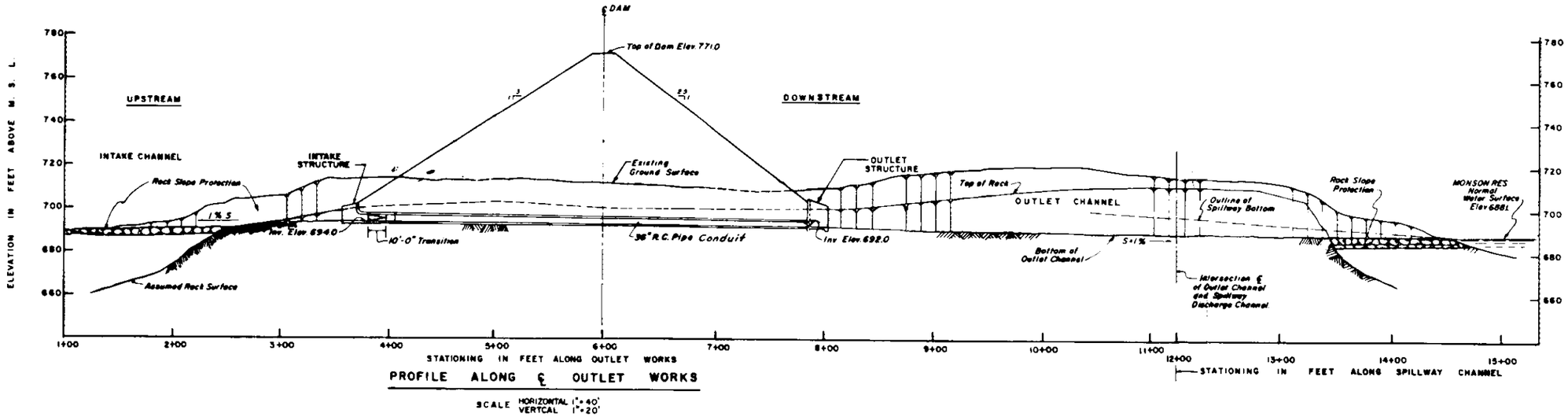
CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN
CONANT BROOK DAM
SPILLWAY
PROFILE & SECTIONS
CHICOPEE RIVER, MASSACHUSETTS

DATE MARCH 1963

PLATE G-10

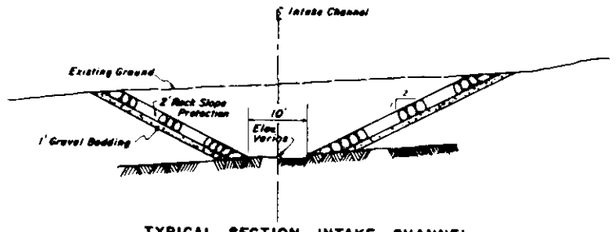
CORPS OF ENGINEERS

U S ARMY



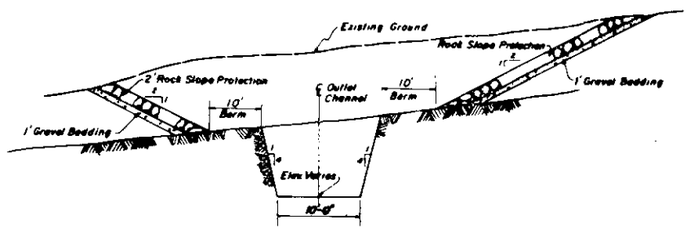
PROFILE ALONG ℄ OUTLET WORKS

SCALE HORIZONTAL 1"=40'
VERTICAL 1"=20'



TYPICAL SECTION INTAKE CHANNEL

NOT TO SCALE



TYPICAL SECTION OUTLET CHANNEL

NOT TO SCALE

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY | TR. BY: MWB | CK. BY

PROJECT ENGINEER

LEVEL DATUM

SUBMITTED BY

CHIEF, PLANS & EST'S BRANCH

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN
CONANT BROOK DAM
OUTLET WORKS
PROFILE & SECTIONS
CHICOPEE RIVER, MASSACHUSETTS

APPROVED

DATE MARCH 1963

CHIEF ENGINEERING DIV.

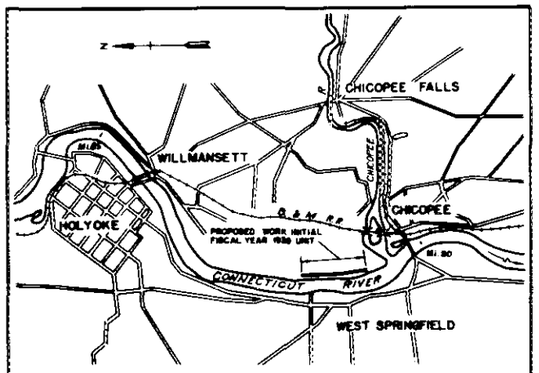
SCALE

SPEC. NO. CIV

DRAWING NUMBER

CHIEF

PLATE G-11

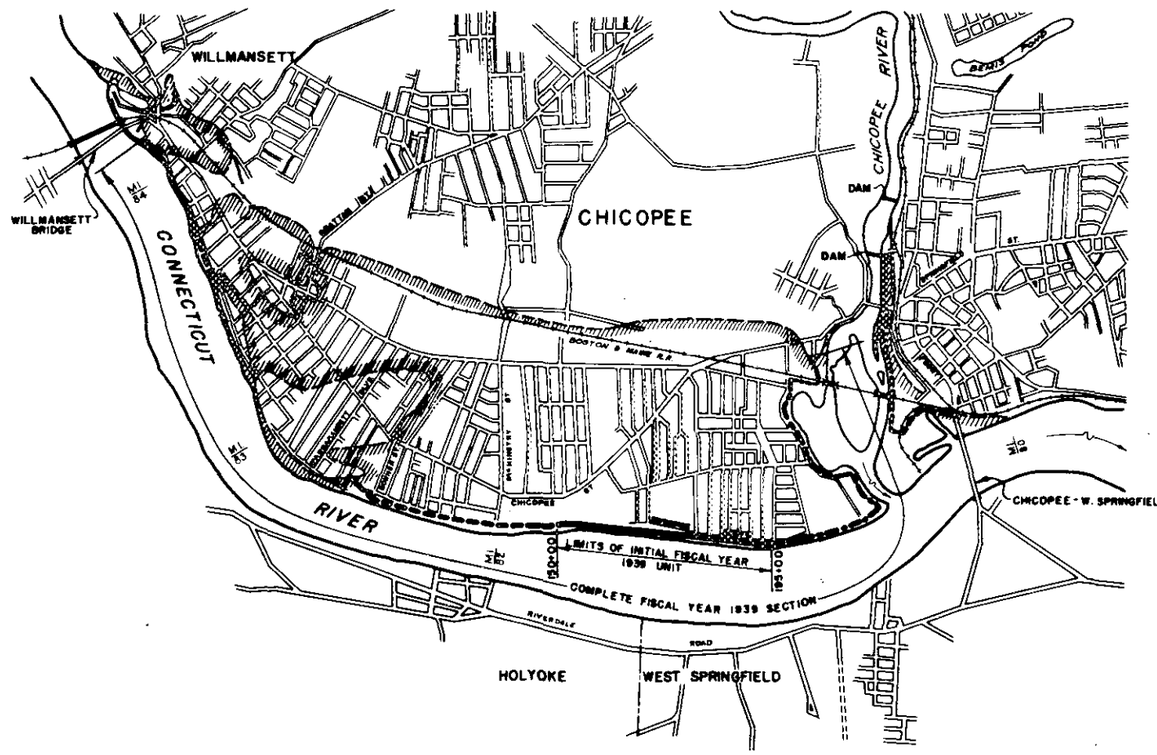


VICINITY MAP

SCALE 1 IN = 1 MI.

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION	FILE NUMBER
1	PROJECT LOCATION AND INDEX	CT-4-1122
2.	SUBSURFACE EXPLORATION	CT-2-1106
3.	BORROW AREAS	CT-2-1111
4.	GENERAL PLAN (Sta. 0+00 to 21+20)	CT-4-1121
5.	GENERAL PLAN (Sta. 21+20 to 44+87.57±)	CT-4-1120
6.	EMBANKMENT DETAILS	CT-4-1137
7.	TOE DRAIN PROFILE AND SECTIONS	CT-4-1311



LEGEND

Project

Present Dike

Future Construction

Overflow Limits of the March 1936 Flood

RECORD DRAWINGS

DATE	REVISION	REV. BY	CK. BY	AP. BY
3-3-39	ADDED SHEET NO. 7 TO SET	P.C.H.	[illegible]	[illegible]

CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE DIKE

INITIAL FISCAL YEAR 1939 UNIT

PROJECT LOCATION AND INDEX

CHICOPEE, MASS.

CONNECTICUT RIVER MASSACHUSETTS

IN 7 SHEETS SCALE 1 IN. = 1200 FT. SHEET NO. 1

1200' 0 1200' 2400'

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., OCT. 1938

SUBMITTED: [signature] SENIOR ENGINEER, HEAD, DESIGN SECTION

APPROVAL RECOMMENDED: [signature] PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIVISION

APPROVED: [signature] LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

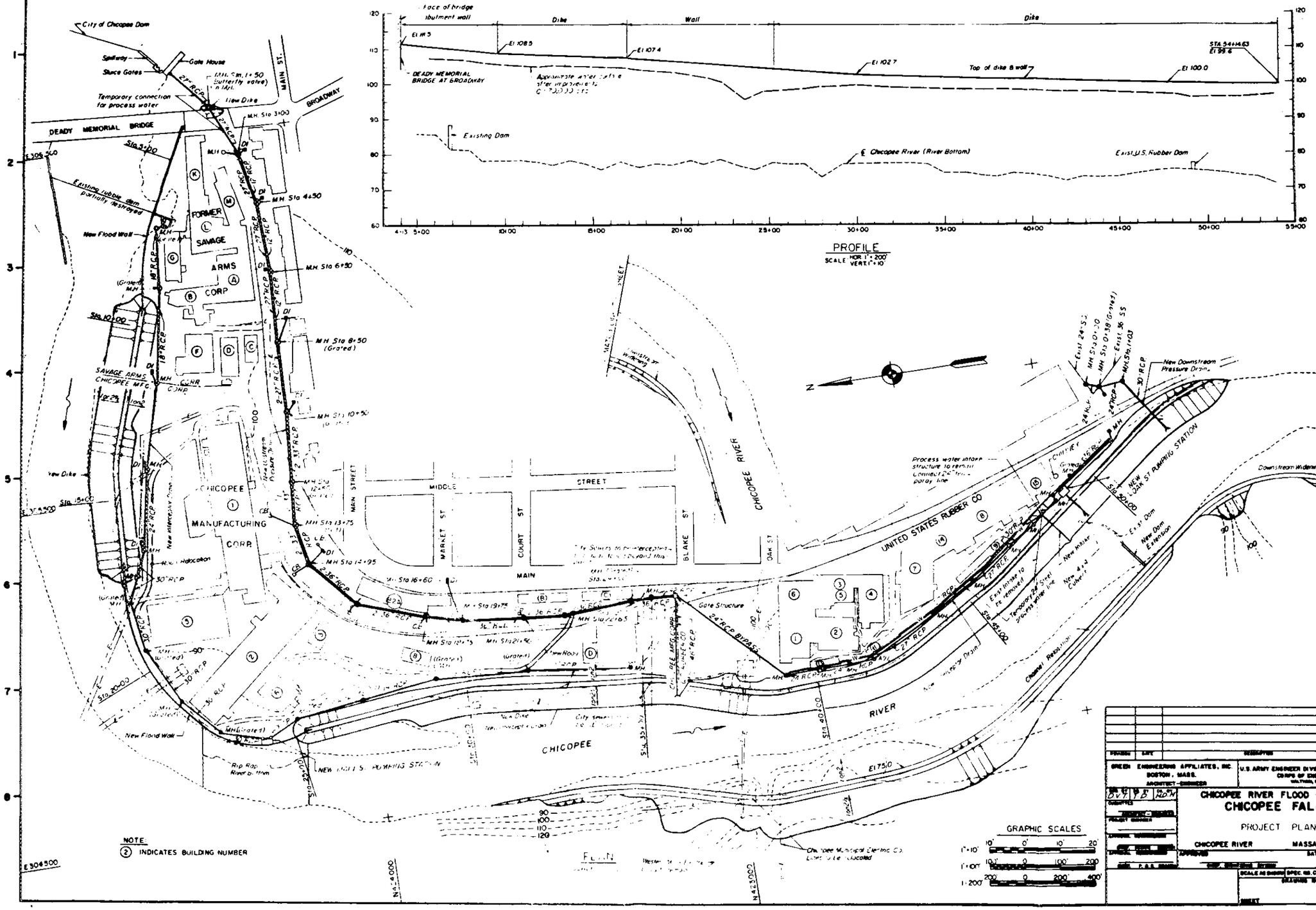
DESIGNED: P.C. Hammond, ASST. ENGINEER

DRAWN BY: TRACED BY: M.R. CHECKED BY: P.C.H.

FILE NO. CT-4-1122 TO ACCOMPANY DATED OCT. 29, 1938

PLATE G-12 (1)

CORPS OF ENGINEERS — U.S. ARMY



PROFILE
SCALE HOR 1" = 200'
VERT 1" = 10'

GRAPHIC SCALES
1"=10' 10' 0' 10' 20'
1"=100' 100' 0 100' 200'
1"=200' 200' 0 200' 400'

GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ARCHITECT-ENGINEER		U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	
DES. BY DVV	DR. BY JB	TR. BY JCM	
CHECKED			
PROJECT ENGINEER			
GENERAL SUPERVISION			
CHIEF, ENGINEERING DIVISION			
CHIEF, CONSTRUCTION DIVISION			
CHIEF, P.P.& R. BRANCH			

CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
PROJECT PLAN
CHICOPEE RIVER — MASSACHUSETTS
APPROVED — DATE DEC. 1962
SCALE AS SHOWN — SPEC. NO. CIV. ENG.-10-060-63-1 — DRAWING NUMBER

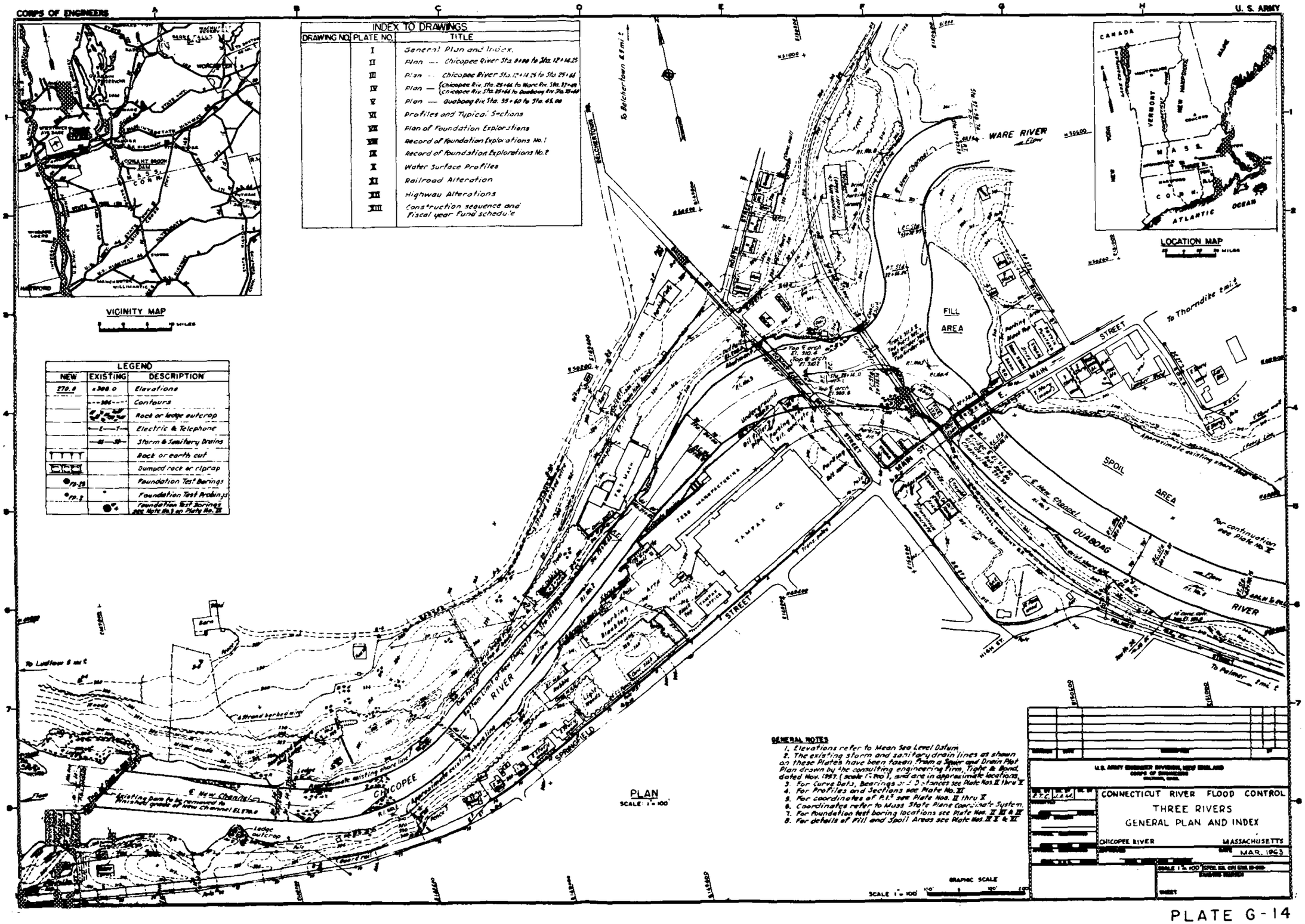
PLATE G-13

CORPS OF ENGINEERS — U. S. ARMY

VICINITY MAP

INDEX TO DRAWINGS		
DRAWING NO.	PLATE NO.	TITLE
	I	General Plan and Index.
	II	Plan — Chicopee River Sta. 0+00 to Sta. 12+14.25
	III	Plan — Chicopee River Sta. 12+14.25 to Sta. 25+66
	IV	Plan — Chicopee Riv. Sta. 25+66 to Ware Riv. Sta. 37+09; Chicopee Riv. Sta. 25+66 to Quaboag Riv. Sta. 39+48
	V	Plan — Quaboag Riv. Sta. 35+60 to Sta. 65.00
	VI	Profiles and Typical Sections
	VII	Plan of Foundation Explorations
	VIII	Record of Foundation Explorations No. 1
	IX	Record of Foundation Explorations No. 2
	X	Water Surface Profiles
	XI	Railroad Alteration
	XII	Highway Alterations
	XIII	Construction sequence and fiscal year fund schedule

LEGEND		
NEW	EXISTING	DESCRIPTION
770.5	+300.0	Elevations
	--300--	Contours
		Rock or ledge outcrop
	—E—T—	Electric & Telephone
	—S—D—	Storm & Sanitary Drains
		Rock or earth cut
		Dumped rock or riprap
		Foundation Test Borings
		Foundation Test Probings
		Foundation Test Borings (see Note No. 3 on Plate No. II)


To Belchertown 4.5 mi.
WARE RIVER
CANADA
VERMONT
MASS.
CONN.
ATLANTIC OCEAN
LOCATION MAP
FILL AREA
STREET
MAIN
To Thorndike 2 mi.
SPOIL AREA
QUABOAG
RIVER
For continuation see Plate No. X
TAMPAX CO.
ZERO MANUFACTURING
SPRINGFIELD
CHICOPEE
RIVER
To Ludlow 6 mi.
To Palmer 5 mi.
Existing dam to be removed to finished grade of new Channel El. 316.0
Approximate existing shore line
Ledge outcrop
Barn
Stone wall
Wood rail
Fence
Top C arch El. 310.6
Top R arch El. 307.1
Top C arch El. 309.6
Underground Oil Filler
Parking Bldg.
Tampax Office
Trans Pipe
Light Poles
Tennis Courts
Parking Area
Parking Meter Pay
Public Toilets
Band Stand
Pumping Station
Fire Station
Police Station
Post Office
Library
Hospital
Nursing Home
Trailer Park
Cemetery
Church
Bridge
Dam
Sluice Gate
Flood Wall
Levee
Pipe Line
Power Line
Tower
Pole
Hydrant
Manhole
Catch Basin
Gate
Valve
Culvert
Ditch
Swamp
Woods
Brush
Orchard
Lawn
Sand
Gravel
Pit
Quarry
Dump
Road
Path
Trail
Bridge
Railroad
Station
Yard
Switch
Signal
Crossing
Gate
Fence
Wall
Building
House
Garage
Shed
Barn
Silo
Tank

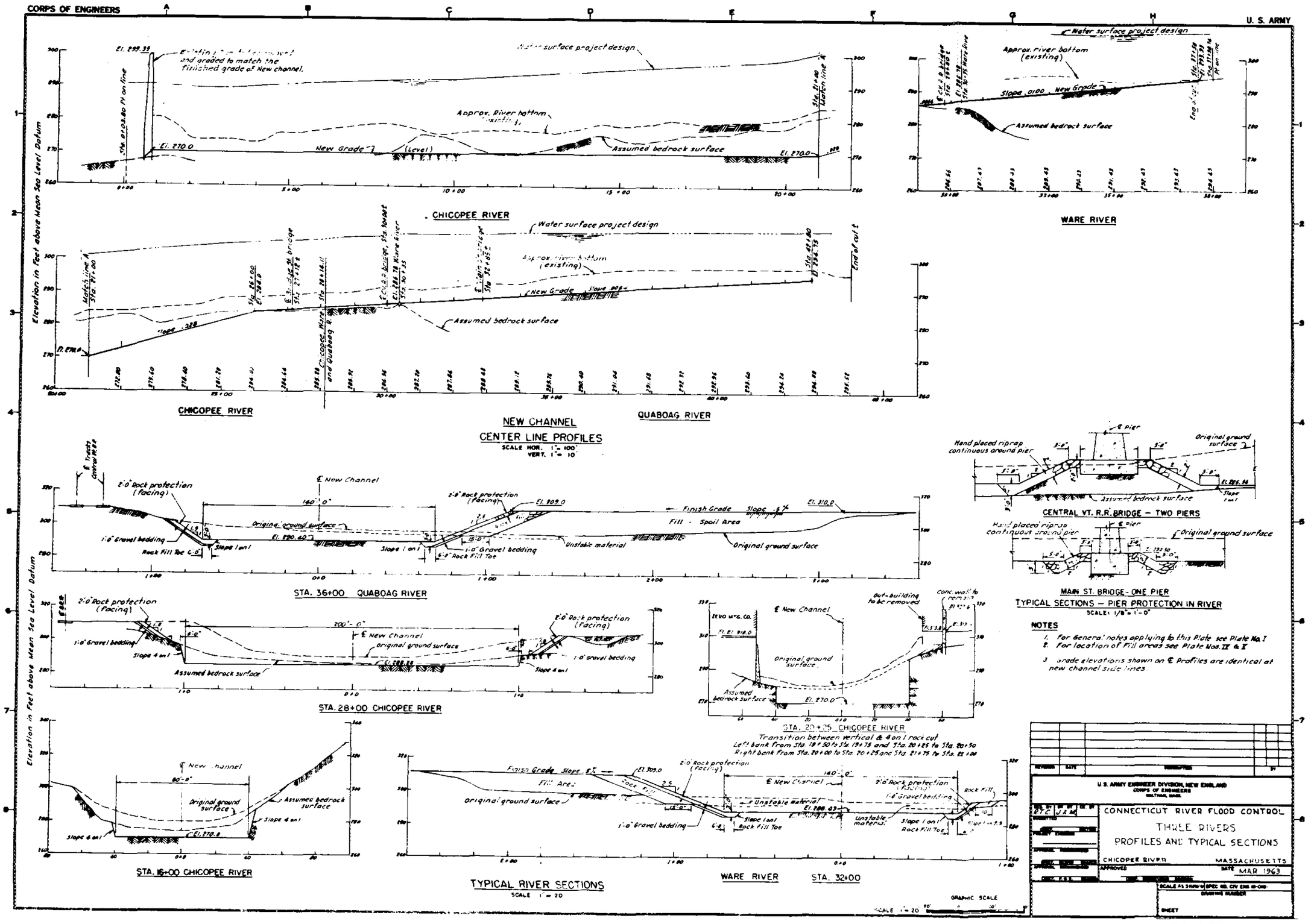
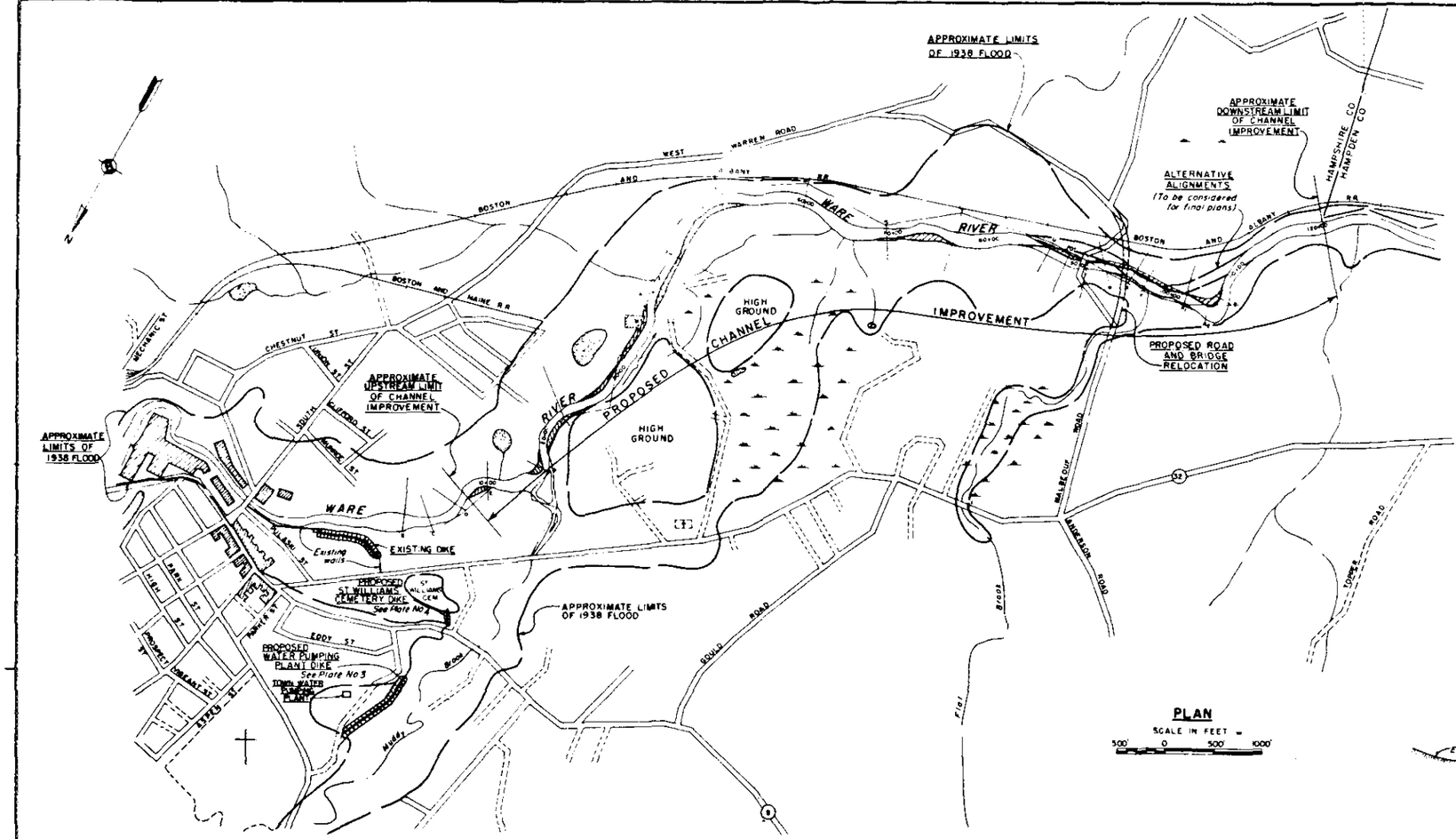

CORPS OF ENGINEERS
U. S. ARMY
Elevation in Feet above Mean Sea Level Datum
CHICOPEE RIVER
WARE RIVER
Water surface project design
Approx. River bottom (existing)
New Grade
Assumed bedrock surface
Slope .0100
Slope .028
Slope .0064
Match line A
End of cut
Chicopee, Ware and Quaboag R.
QUABOAG RIVER
NEW CHANNEL
CENTER LINE PROFILES
SCALE HOR. 1" = 100'
VERT. 1" = 10'
STA. 36+00 QUABOAG RIVER
STA. 28+00 CHICOPEE RIVER
STA. 20+25 CHICOPEE RIVER
Transition between vertical & 4 on 1 rock cut
Left bank from Sta. 19+50 to Sta. 19+75 and Sta. 20+25 to Sta. 20+50
Right bank from Sta. 20+00 to Sta. 20+25 and Sta. 21+75 to Sta. 22+00
STA. 16+00 CHICOPEE RIVER
WARE RIVER STA. 32+00
TYPICAL RIVER SECTIONS
SCALE 1" = 20'
CENTRAL VT. R.R. BRIDGE – TWO PIERS
MAIN ST. BRIDGE - ONE PIER
TYPICAL SECTIONS – PIER PROTECTION IN RIVER
SCALE: 1/8" = 1'-0"
NOTES
1. For General notes applying to this Plate see Plate No. I
2. For location of Fill areas see Plate Nos. IV & V
3. Grade elevations shown on ℄ Profiles are identical at new channel side lines.
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
CONNECTICUT RIVER FLOOD CONTROL
THREE RIVERS
PROFILES AND TYPICAL SECTIONS
CHICOPEE RIVER
MASSACHUSETTS
MAR 1963

PLATE G-15

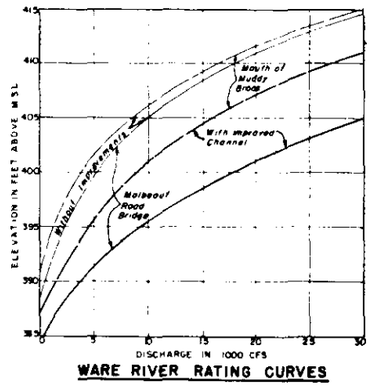
CORPS OF ENGINEERS

U. S. ARMY



PLAN

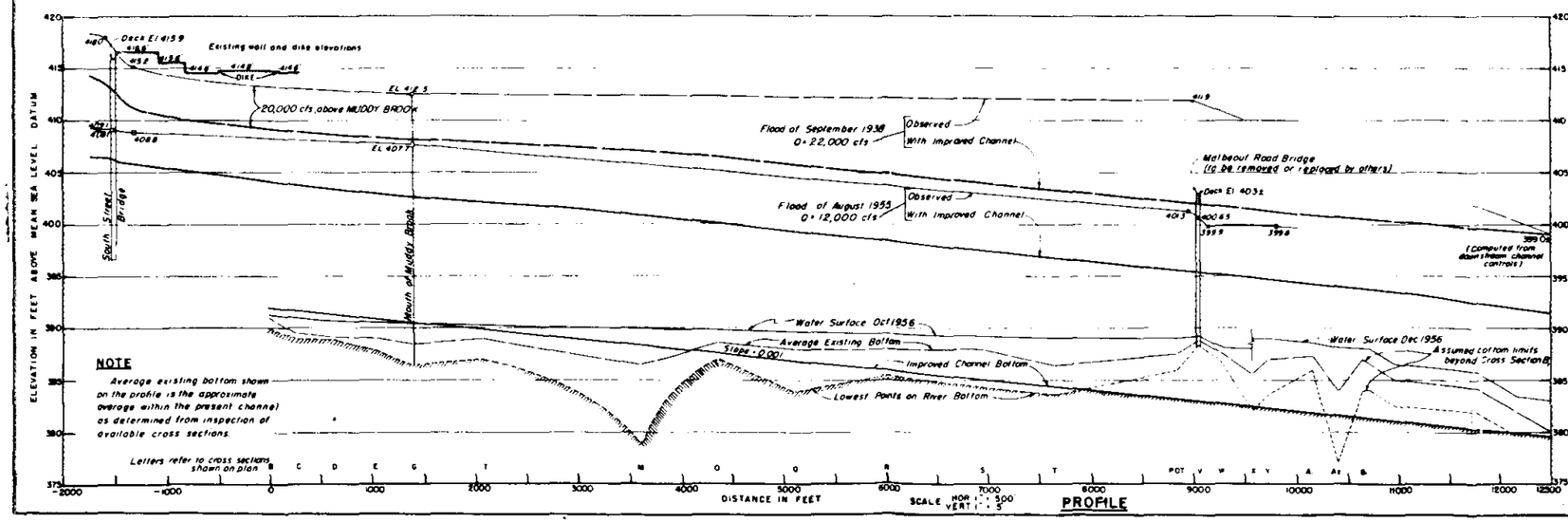
SCALE IN FEET
500' 0 500' 1000'



WARE RIVER RATING CURVES

TYPICAL CHANNEL CROSS SECTION

(STA 51+00)
SCALE (" = 20'
20' 0 20' 40'



PROFILE

NOTE

Average existing bottom shown on the profile is the approximate average within the present channel as determined from inspection of available cross sections.

Letters refer to cross sections shown on plan

NOTES

Elevations refer to Mean Sea Level Datum

Where improved channel bottom is above elevation of existing channel it refers to excavation for increased width as shown on Typical Channel Cross Section

Locations of spoil areas will be developed for final plans

Cross hatched areas indicate approximate areas to be widened

CORPS OF ENGINEERS — U. S. ARMY

JEM AJH

CONNECTICUT RIVER FLOOD CONTROL
WARE, MASS.

LOCAL PROTECTION
GENERAL PLAN AND PROFILE

WARE RIVER — MASSACHUSETTS

APRIL 1957

AS SHOWN

CT-1-4437

PLATE G-16

CORPS OF ENGINEERS

U S ARMY

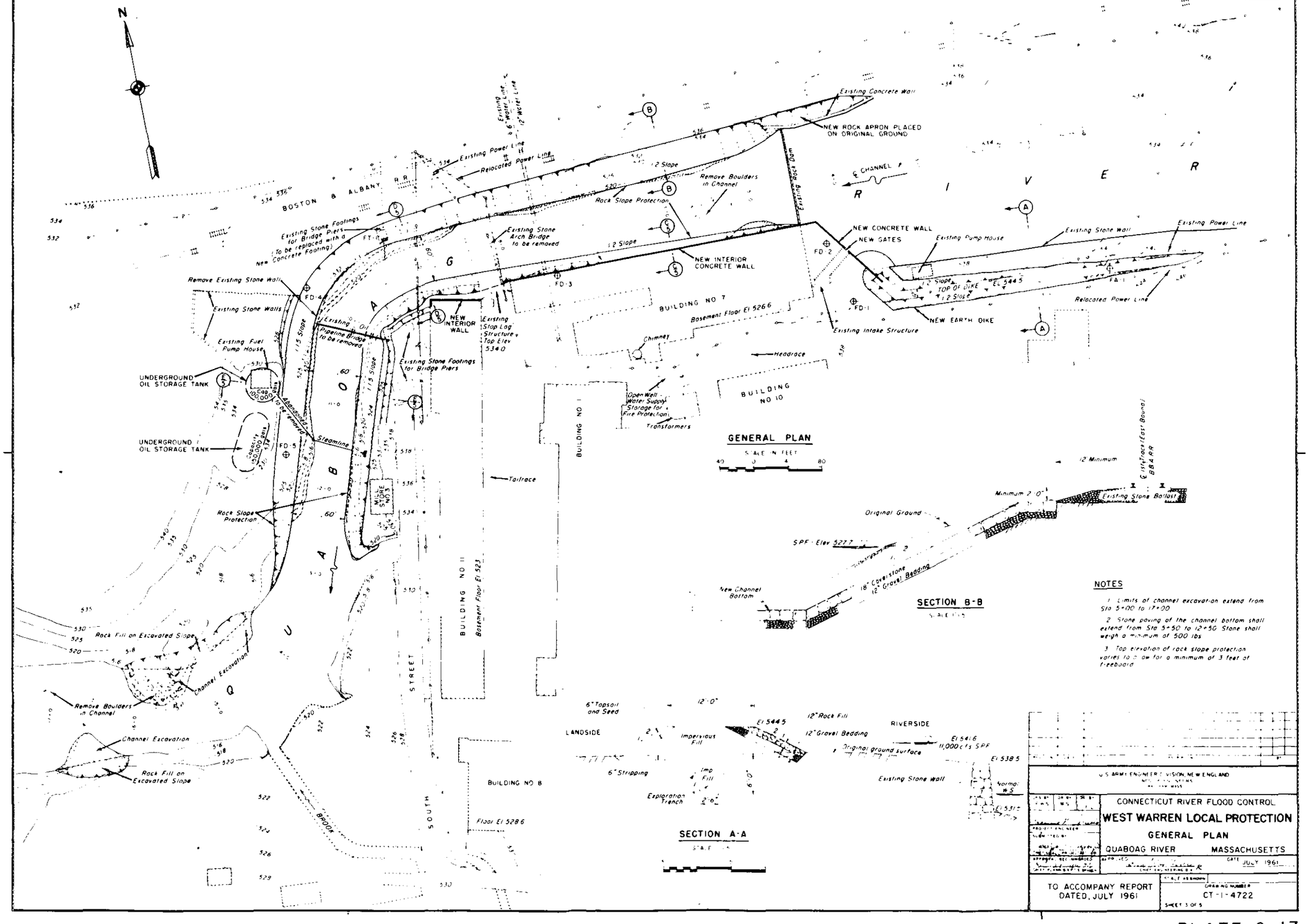
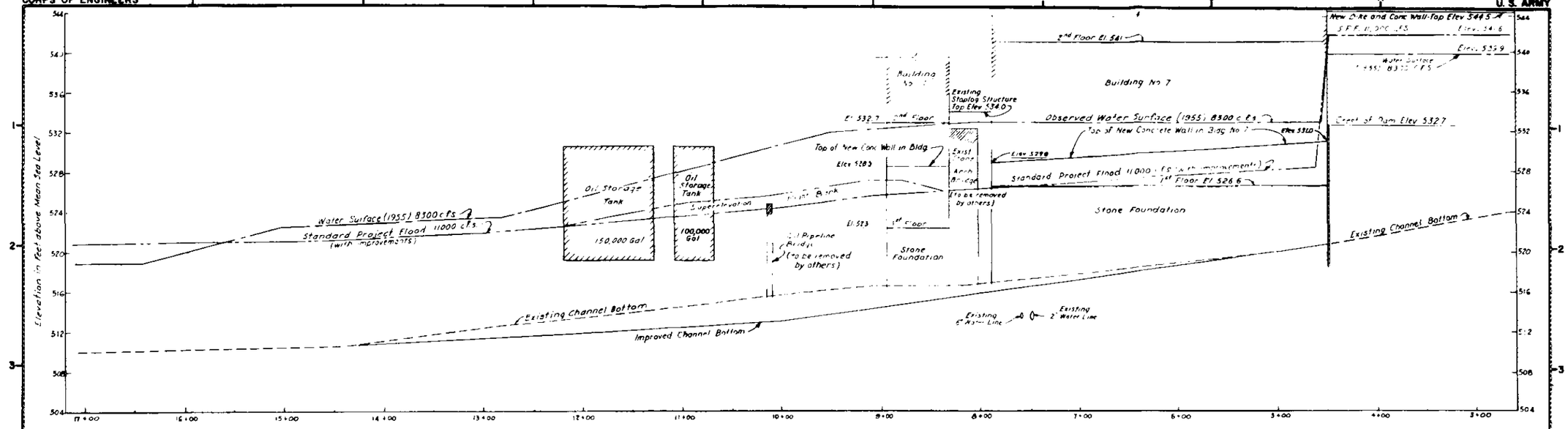


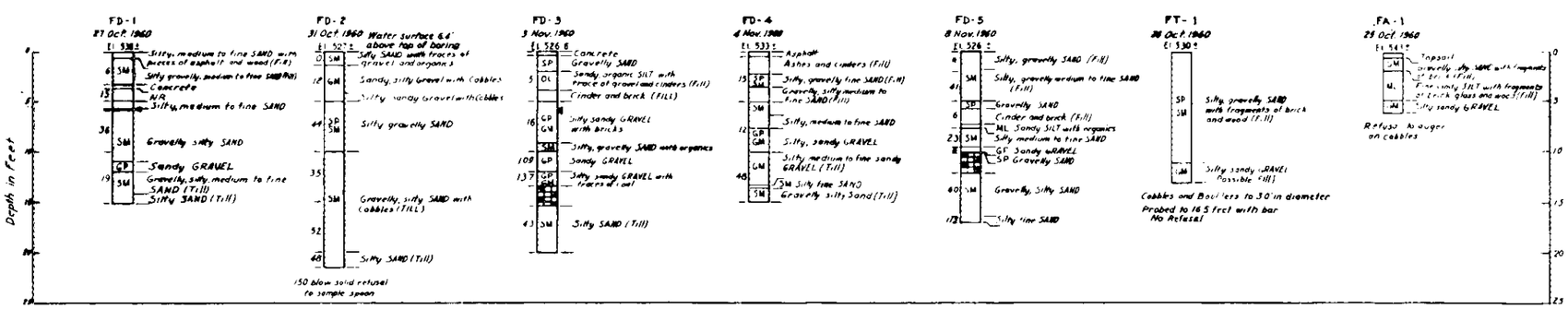
PLATE G-17

CORPS OF ENGINEERS — U.S. ARMY



℄ PROFILE

SCALE: HORIZONTAL 1" = 40'-0"
VERTICAL 1" = 4'-0"



NOTES

Elevations refer to Mean Sea Level Datum
For location of Subsurface Explorations see Plate No. 3.

RECORD OF EXPLORATIONS

SCALE VERTICAL 1" = 5'

LEGEND FOR GRAPHIC LOGS

FD-5 Foundation Test Boring
FA-1 Foundation Hand Auger Boring
FT-1 Foundation Test Pit
3 Nov 1960 Date Exploration completed
11.526 Elevation of ground surface at time of exploration
Subsurface water level in boring at time of exploration
SM Group letter symbol according to Unified Soil Classification
N.R. No recovery or unsatisfactory soils samples recovered
Blows per foot of penetration considered most representative for each sample given using a 150 pound hammer with a free fall of about 18" on a 1.5" I.D or 2" O.D, 2" I.D or 2.4" O.D and or 2.4" I.D or 3" O.D. size sample spoon equipped with a beveled and sharpened tip shoe
Blow counts not recorded or not considered representative
(cobble or boulder (Core drilled)
(cobbles or boulders, continuous or nested (Core drilled and/or blasted and chopped)

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

CONNECTICUT RIVER FLOOD CONTROL
WEST WARREN LOCAL PROTECTION
PROFILE AND EXPLORATIONS
QUABOAG RIVER MASSACHUSETTS

DATE JULY 1961

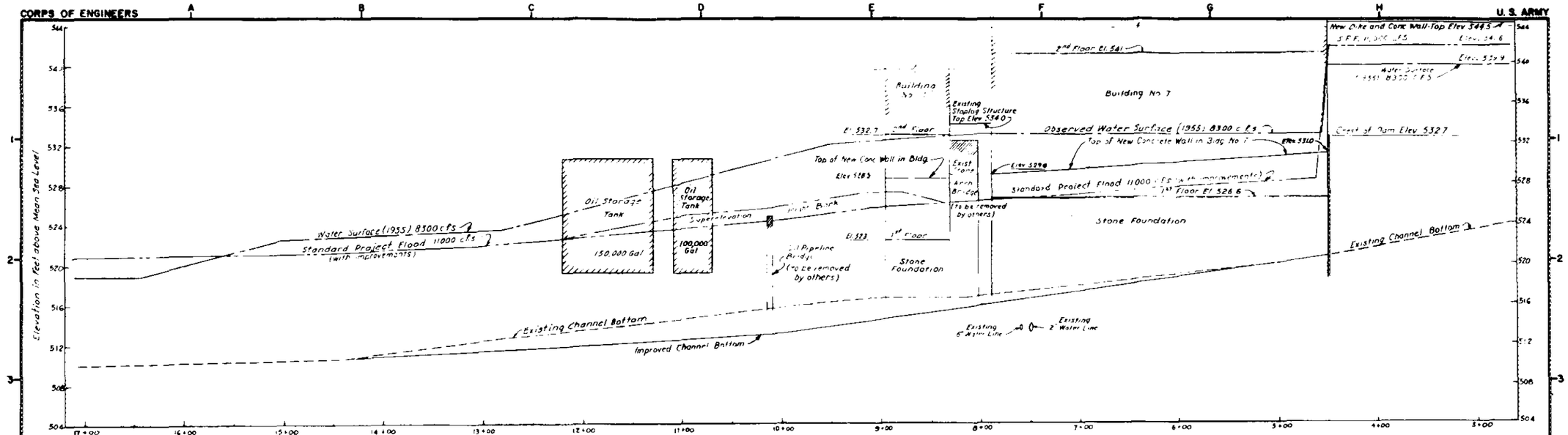
TO ACCOMPANY REPORT DATED, JULY 1961

DRAWING NUMBER CT-1-4723

SHEET 4 OF 8

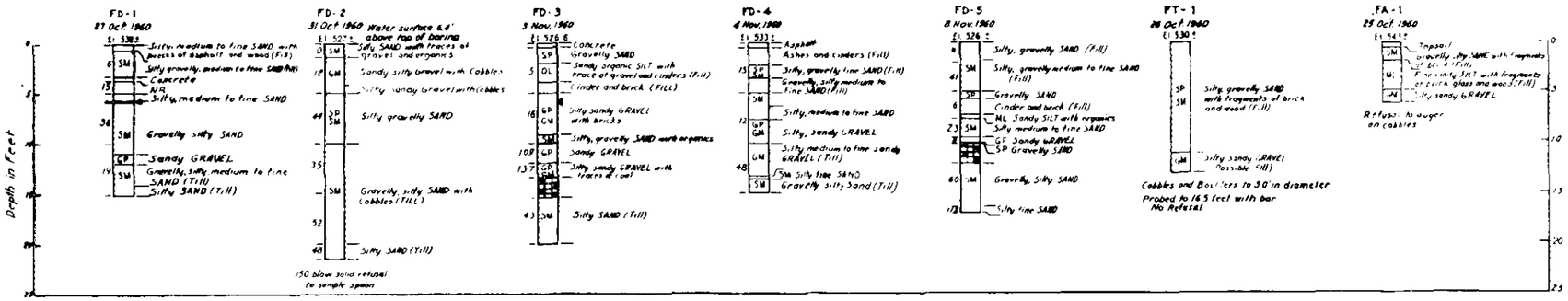
PLATE G-18

CORPS OF ENGINEERS — U.S. ARMY



℄ PROFILE

SCALE: HORIZONTAL 1" = 40'-0"
VERTICAL 1" = 4'-0"



RECORD OF EXPLORATIONS

SCALE VERTICAL 1" = 5'

NOTES

Elevations refer to Mean Sea Level Datum.
For location of Subsurface Explorations see Plate No 3.

LEGEND FOR GRAPHICLOGS

FD-5 Foundation Test Boring
FA-1 Foundation Hand Auger Boring
FT 1 Foundation Test Pit
3 Nov 1960 Date Exploration completed
El 526 Elevation of ground surface at time of exploration
Subsurface water level in boring at time of exploration
SM Group letter symbol according to Unified Soil Classification
NR No recovery or unsatisfactory split samples recovered
23 Blows per foot of penetration considered most representative for each sample drive using a 350 pound hammer with a free fall of about 18" on a 1 3/8" I.D. or 2" O.D., 2" I.D. or 2 3/8" O.D. and or 2 1/2" I.D. or 3" O.D. size sample spoon equipped with a beveled and sharpened drive shoe
Blow counts not recorded or not considered representative
Cobble or boulder (Core drilled)
Cobbles or boulders, continuous or nested (Core drilled and/or blasted and chopped)

No.	Date	Description

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES BY E.P.B. | DR BY W.S. | CK BY

CONNECTICUT RIVER FLOOD CONTROL
WEST WARREN LOCAL PROTECTION
PROFILE AND EXPLORATIONS
QUABOAG RIVER MASSACHUSETTS

APPROVED DATE JULY 1961

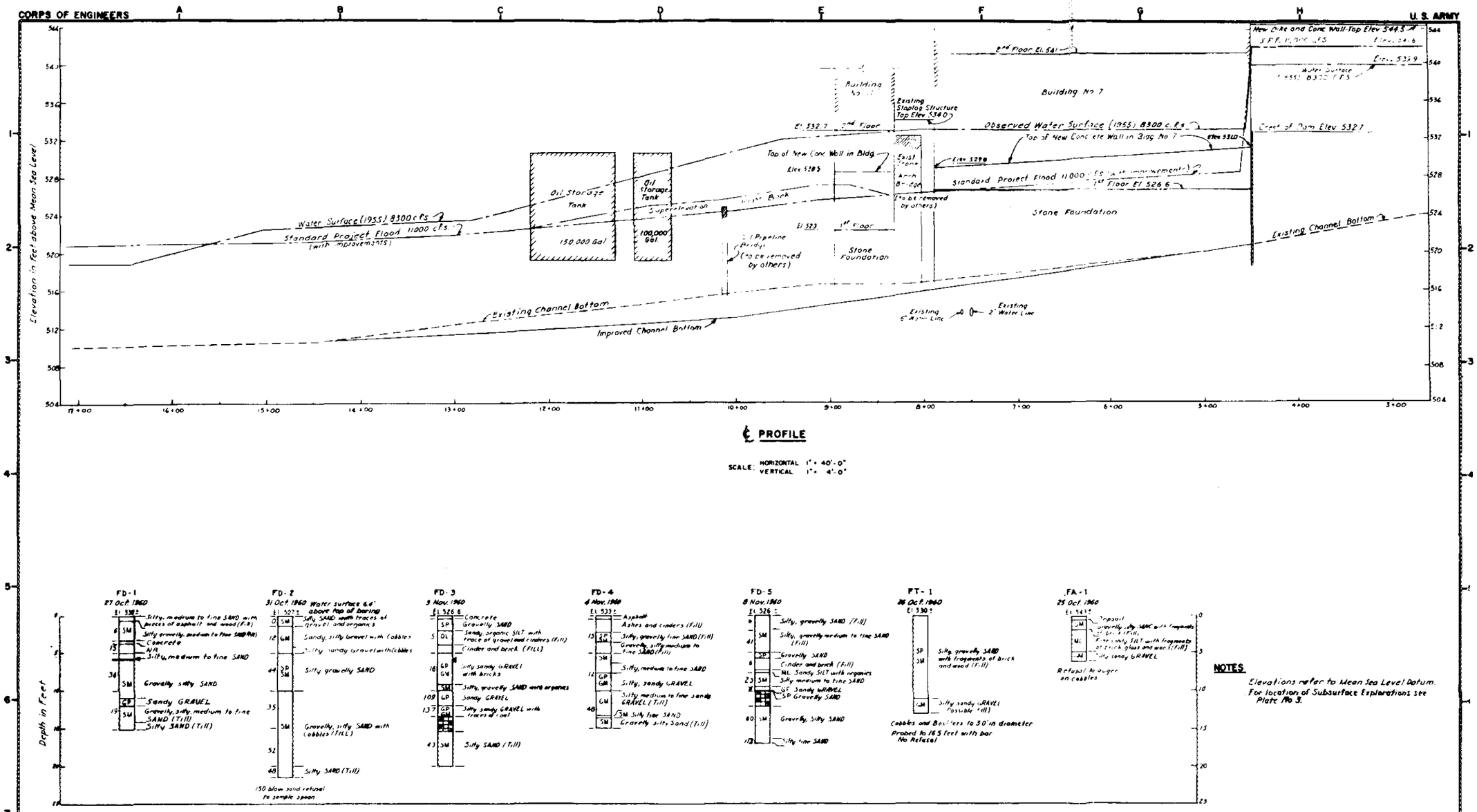
TO ACCOMPANY REPORT DATED, JULY 1961

SCALE AS SHOWN

DRAWING NUMBER CT-1-4723

SHEET 4 OF 6

PLATE G-18



℄ PROFILE

SCALE: HORIZONTAL 1" = 40'-0"
VERTICAL 1" = 4'-0"

RECORD OF EXPLORATIONS

SCALE VERTICAL 1" = 5'

NOTES

Elevations refer to Mean Sea Level Datum.
For location of Subsurface Explorations see Plate No 3.

LEGEND FOR GRAPHIC LOGS

FD-5 Foundation Test Boring
FA-1 Foundation Hand Auger Boring
FT-1 Foundation Test Pit
3 Nov 1960 Date Exploration completed
El 526 Elevation of ground surface at time of exploration
Subsurface water level in boring at time of exploration
SM Group letter symbol according to Unified Soil Classification
NR No recovery or unsatisfactory soils samples recovered
Blows per foot of penetration considered most representative for each sample drive using a 150 pound hammer with a free fall of about 18" on a 1½" I.D. or 2" O.D., 2" I.D. or 2½" O.D. and or 2½" I.D. or 3" O.D. size sample spoon equipped with a beveled and sharpened drive shoe
Blow counts not recorded or not considered representative
(cobble or boulder (Core drilled)
Cobbles or boulders continuous or nested (core drilled and/or blasted and chopped)

REVISION	DATE	DESCRIPTION

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

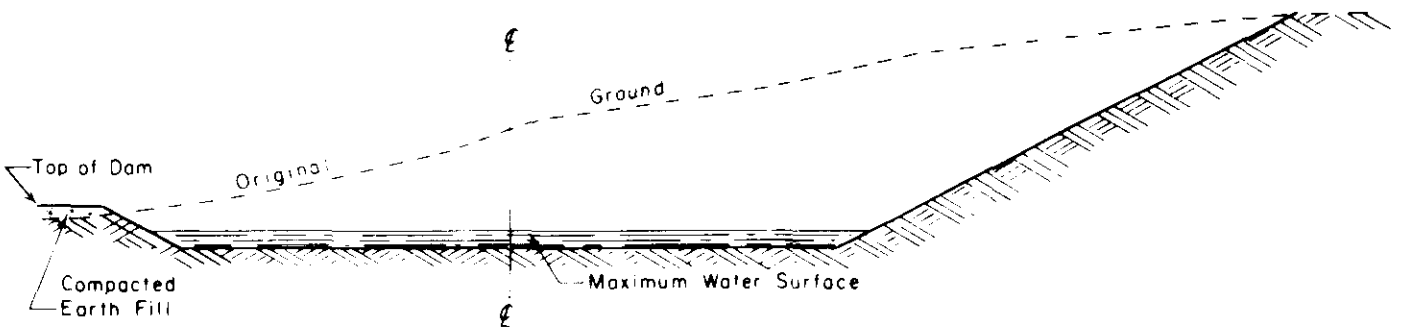
CONNECTICUT RIVER FLOOD CONTROL
WEST WARREN LOCAL PROTECTION
PROFILE AND EXPLORATIONS
QUABOAG RIVER MASSACHUSETTS

DATE JULY 1961

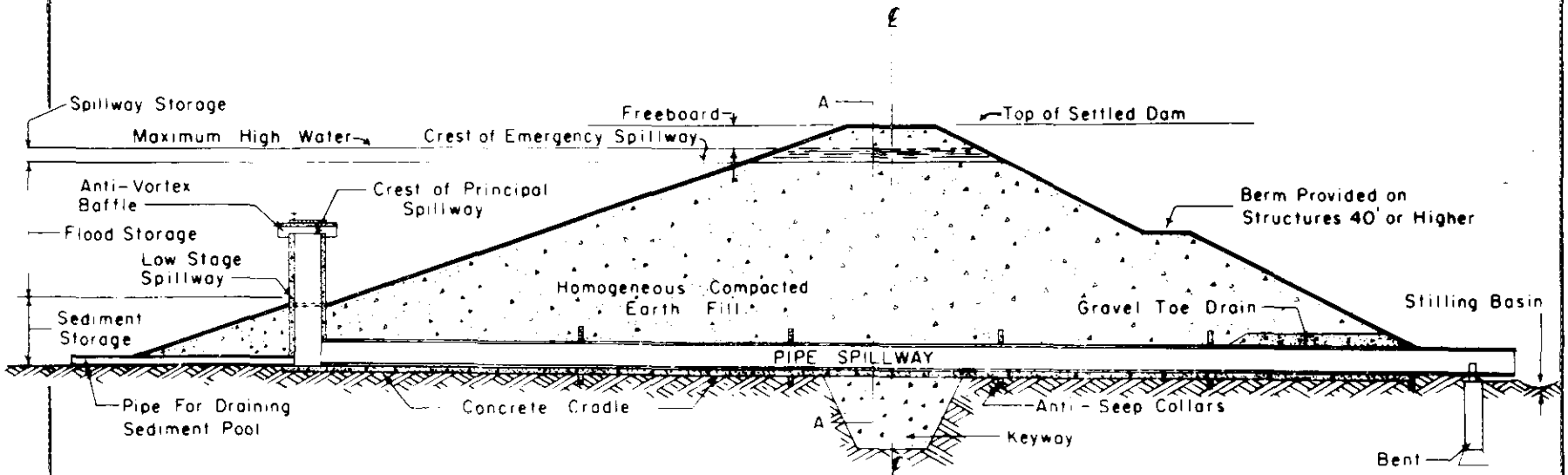
TO ACCOMPANY REPORT DATED, JULY 1961

SCALE AS SHOWN
DRAWING NUMBER CT-1-4723
SHEET 4 OF 8

PLATE G-18

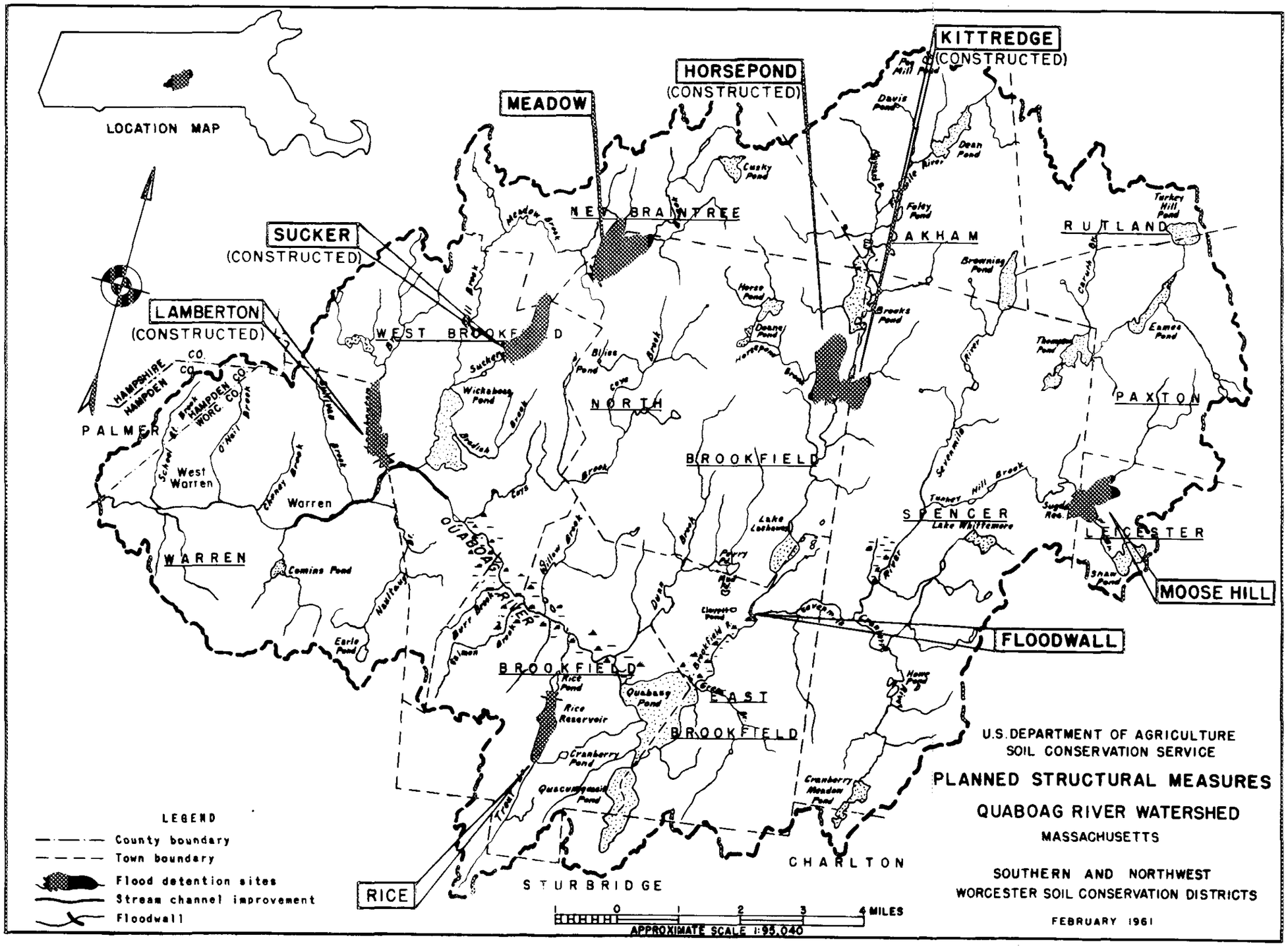


SECTION A-A
CROSS SECTION OF EMERGENCY SPILLWAY
CONTROL SECTION



TYPICAL CROSS SECTION OF FLOODWATER RETARDING STRUCTURE
ALONG PRINCIPAL AND EMERGENCY SPILLWAYS
U.S. SOIL CONSERVATION SERVICE

PLATE G-19



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLANNED STRUCTURAL MEASURES

QUABOAG RIVER WATERSHED

MASSACHUSETTS

SOUTHERN AND NORTHWEST
WORCESTER SOIL CONSERVATION DISTRICTS

FEBRUARY 1961

PLATE G-20

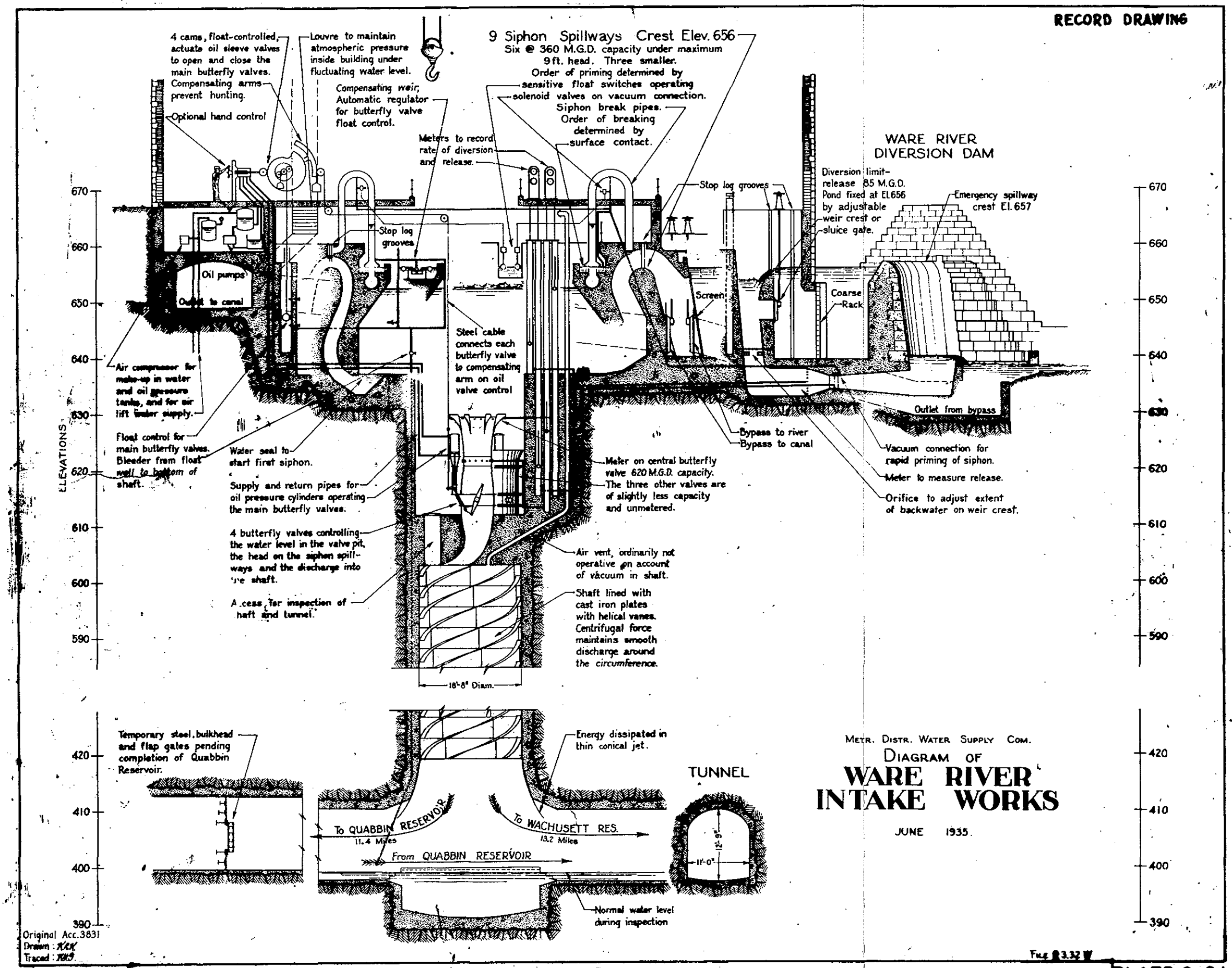
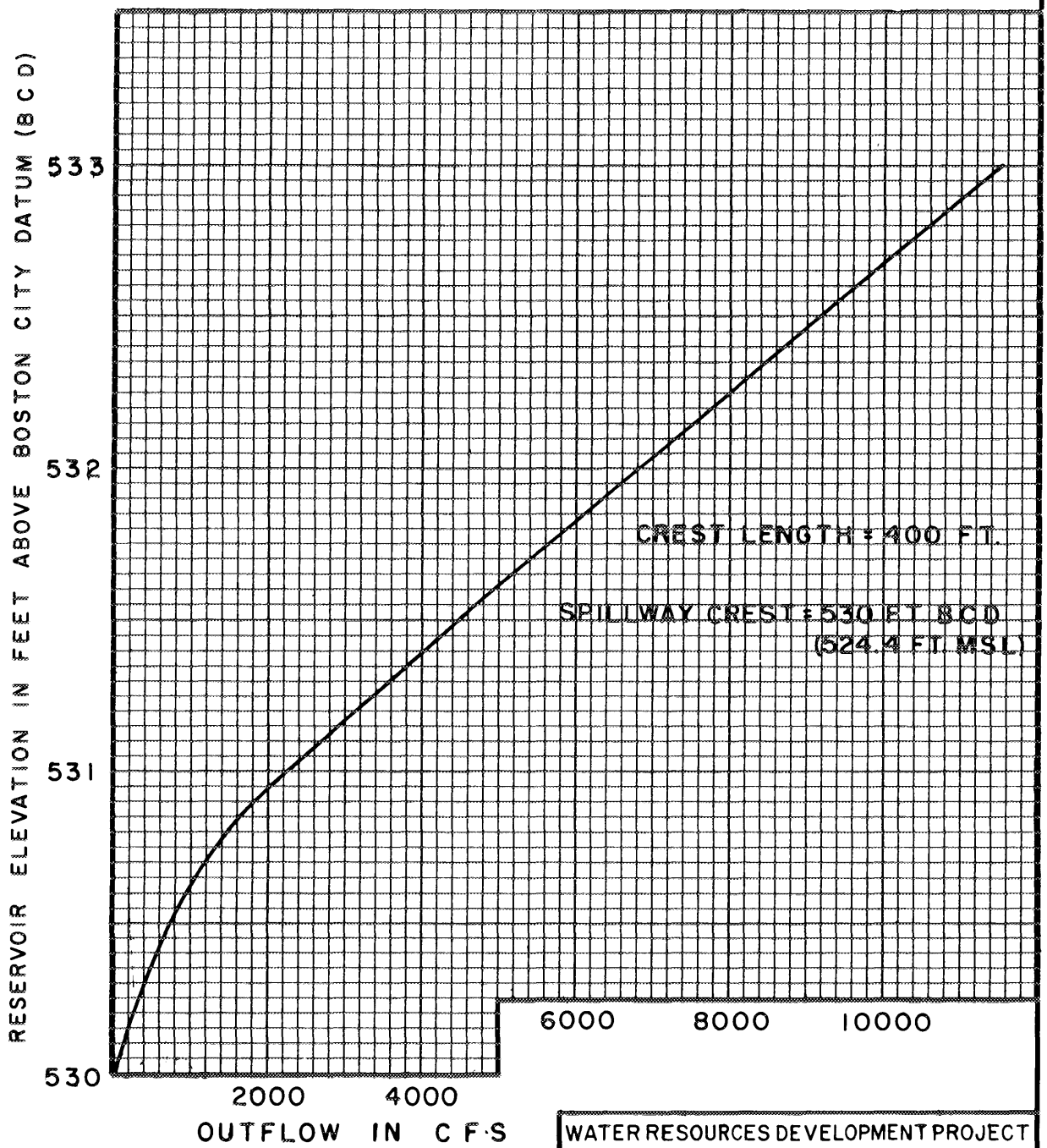

RECORD DRAWING
9 Siphon Spillways Crest Elev. 656
Six @ 360 M.G.D. capacity under maximum 9 ft. head. Three smaller.
Order of priming determined by sensitive float switches operating solenoid valves on vacuum connection.
Siphon break pipes.
Order of breaking determined by surface contact.
4 cams, float-controlled, actuate oil sleeve valves to open and close the main butterfly valves. Compensating arms prevent hunting.
Louvre to maintain atmospheric pressure inside building under fluctuating water level.
Compensating weir; Automatic regulator for butterfly valve float control.
Optional hand control
Meters to record rate of diversion and release.
WARE RIVER DIVERSION DAM
Stop log grooves
Diversion limit-release 85 M.G.D. Pond fixed at El. 656 by adjustable weir crest or sluice gate.
Emergency spillway crest El. 657
Oil pumps
Outlet to canal
Screen
Coarse Rack
Steel cable connects each butterfly valve to compensating arm on oil valve control
Air compressor for make-up in water and oil pressure tanks, and for air lift water supply.
Float control for main butterfly valves. Bleeder from float well to bottom of shaft.
Water seal to start first siphon.
Supply and return pipes for oil pressure cylinders operating the main butterfly valves.
4 butterfly valves controlling the water level in the valve pit, the head on the siphon spillways and the discharge into the shaft.
Access for inspection of shaft and tunnel.
Meter on central butterfly valve 620 M.G.D. capacity. The three other valves are of slightly less capacity and unmetered.
Air vent, ordinarily not operative on account of vacuum in shaft.
Shaft lined with cast iron plates with helical vanes. Centrifugal force maintains smooth discharge around the circumference.
18'-8" Diam.
Bypass to river
Bypass to canal
Outlet from bypass
Vacuum connection for rapid priming of siphon.
Meter to measure release.
Orifice to adjust extent of backwater on weir crest.
ELEVATIONS
670
660
650
640
630
620
610
600
590
420
410
400
390
Temporary steel bulkhead and flap gates pending completion of Quabbin Reservoir.
Energy dissipated in thin conical jet.
TUNNEL
To QUABBIN RESERVOIR
11.4 Miles
To WACHUSETT RES.
13.2 Miles
From QUABBIN RESERVOIR
12'-9"
11'-0"
Normal water level during inspection
METR. DISTR. WATER SUPPLY COM.
DIAGRAM OF
WARE RIVER INTAKE WORKS
JUNE 1935.
Original Acc. 3831
Drawn: KRK
Traced: KHS
File 3.32 W

PLATE G-21

VIEW OF QUABBIN RESERVOIR



NOTES:

CURVE WAS DEVELOPED FROM INFORMATION PROVIDED BY MASSACHUSETTS MDC. REFER TO PARAGRAPH 3e FOR EXPLANATION OF CURVE.

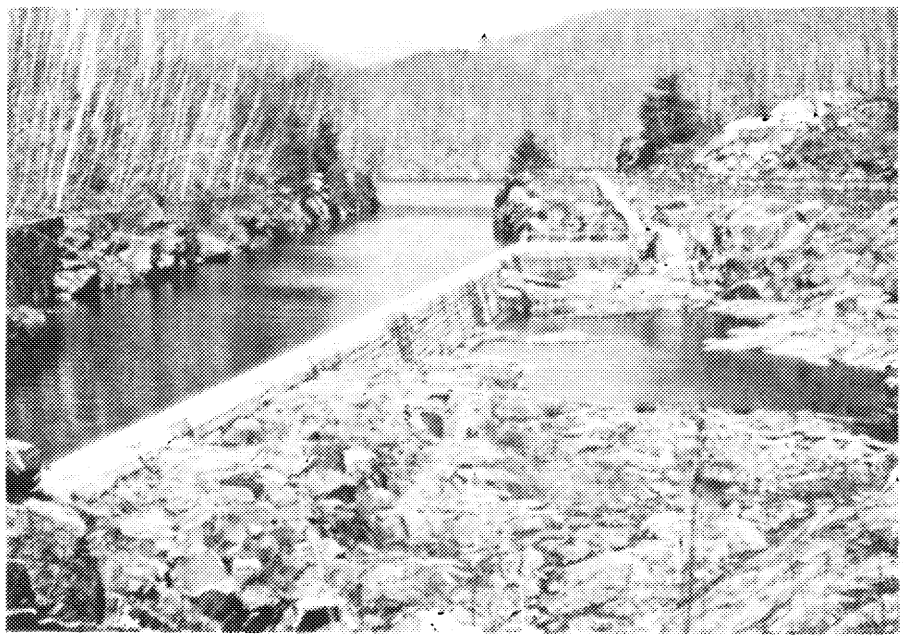
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
QUABBIN RESERVOIR

SPILLWAY RATING CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-23



SPILLWAY - QUABBIN RESERVOIR

STOPLOGS - SPILLWAY, QUABBIN RESERVOIR

PLATE G-24

WATER CONTROL BRANCH
S. COOPER, CHIEF

RESERVOIR CONTROL CENTER
J. FINEGAN, CHIEF

HOUSATONIC RIVER BASIN
R. F. DOHERTY, BASIN REGULATOR

- THOMASTON DAM
  A. HOFFMAN, PROJ. MGR.
  R. M. HOWE, ASSISTANT
- HALL MEADOW BROOK DAM *
- EAST BRANCH DAM *
- NORTHFIELD BROOK LAKE
- HANCOCK BROOK LAKE
- HOP BROOK LAKE
  L. WILLIAMS, PROJ. MGR.
  J. DELONG, ASSISTANT
- BLACK ROCK LAKE
  E.W. FOSTER, PROJ. MGR.
  J. COLLINS, ASSISTANT

CONNECTICUT RIVER BASIN
N. FORBES, UPPER REGULATOR
R.F. DOHERTY, LOWER REGULATOR

- UNION VILLAGE DAM
  R. THRESHER, PROJ. MGR.
  G. PARKER, ASSISTANT
- NORTH HARTLAND LAKE
  J.W. WARD, PROJ. MGR.
  J. DYER, ASSISTANT
- NORTH SPRINGFIELD LAKE
  T. COEN, PROJ. MGR.
  R. WITHINGTON, ASSISTANT
- BALL MOUNTAIN LAKE
  H.C. LOBDELL, PROJ. MGR.
  R. SNOW, ASSISTANT
- TOWNSHEND LAKE
  R. BALLANTINE, PROJ. MGR.
  N. GOODENOUGH, ASSIST.
- SURRY MOUNTAIN LAKE
  V. GUYETTE, PROJ. MGR.
  R TETREAULT, ASSIST.
- OTTER BROOK LAKE
  J. BOYEA, PROJ. MGR.
  D. SHEPARDSON, ASSISTANT
- BIRCH HILL DAM
  J. BACON, PROJ. MGR.
  ASSISTANT
- TULLY LAKE
  R. A. PARKER, PROJ. MGR.
  ASSISTANT
- BARRE FALLS DAM
  C. SABINE, PROJ. MGR.
  G. BOWSE, ASSISTANT
- CONANT BROOK DAM
- LITTLEVILLE LAKE
  J. PARKER, PROJ. MGR.
  M. CAPUTO, ASSISTANT
- KNIGHTVILLE DAM
  L.W. LAFOND, PROJ. MGR.
  J. JOHNSON, ASSISTANT
- COLEBROOK RIVER LAKE
  P.R. LEWIS, PROJ. MGR.
  D. GREENE, ASSISTANT
- MAD RIVER DAM *
- SUCKER BROOK DAM *

THAMES RIVER BASIN
T.D. BUCKELEW, BASIN REGULATOR

- MANSFIELD HOLLOW LAKE
  W. HAWTHORNE, PROJ. MGR.
  D. WARREN, ASSISTANT
- BUFFUMVILLE LAKE
  J.B. HAY, PROJ. MGR.
  R. FREYTAG, ASSISTANT
- HODGES VILLAGE DAM
  D.W. CLARK, PROJ. MGR.
  ASSISTANT
- EAST BRIMFIELD LAKE
  L.J. ROBERTS, PROJ. MGR.
  , ASSISTANT
- WESTVILLE LAKE
  W.T. SMITH, PROJ. MGR.
  R.J. TRYBA, ASSISTANT
- WEST THOMPSON LAKE
  C.A. BUSWELL, PROJ. MGR.
  E. GLASS, ASSISTANT

BLACKSTONE RIVER BASIN
N. FORBES, BASIN REGULATOR

- WEST HILL DAM
  J.M. CLARKIN, PROJ. MGR.

MERRIMACK RIVER BASIN
R.W. MIRICK, BASIN REGULATOR

- FRANKLIN FALLS DAM
  R.D. MAYO, PROJ. MGR.
  O. LAROCHE, ASSIST.
- BLACKWATER DAM
  J. ROBERTS, PROJ. MGR.
- EDWARD MACDOWELL DAM
  J. RATHBURN, PROJ. MGR.
  K.B. WETHERBEE, ASSIST.
- HOPKINTON LAKE
  R.A. GOLEC, PROJ. MGR.
  E.P. MCCABE, ASSISTANT
- EVERETT LAKE
  J.A. PLIFKA, PROJ. MGR.
  W. TURNER, ASSISTANT

HURRICANE BARRIERS
R.F. DOHERTY, REGULATOR

- NEW BEDFORD BARRIER
  J.J. ARRUDA, PROJ. MGR.
  F.M. CALDWELL, ASSIST.
- STAMFORD BARRIER
  J. KATSURAMIS, PROJ. MGR.
- FOX POINT BARRIER
  ADVISORIES TO
  PROVIDENCE R.I.
  PUBLIC WORKS DEPT.
- PAWCATUCK, CONN.
  ADVISORIES TO
  POLICE CHIEF.

RCC ASSISTANTS
P.E. HETU

WCB ASSISTANTS
T.M. BARKER
D.M. BUELOW
P. J. BURNS
O.L. DONATI
T.M. FEENEY
T.M. GEIB
P. J. MARINELLI
H.F. MCMILLAN
R.P. MICHIELUTTI
W.J. MULLIN
S.D. PARKER
C.J. WENER

RESERVOIR MANAGERS	
R MORGAN	HOUSATONIC R. BASIN
S. ALEXANDER	THAMES R. BASIN
A. SAWICKI	MERRIMACK R. BASIN
M. CURRAN	CONN. R. BASIN (UPPER)
J. LEDGERE	CONN. R. BASIN (LOWER)

ORGANIZATION CHART FOR RESERVOIR REGULATION

DIVISION ENGINEER
ENGINEERING DIVISION
WATER CONTROL BRANCH
RESERVOIR CONTROL CENTER

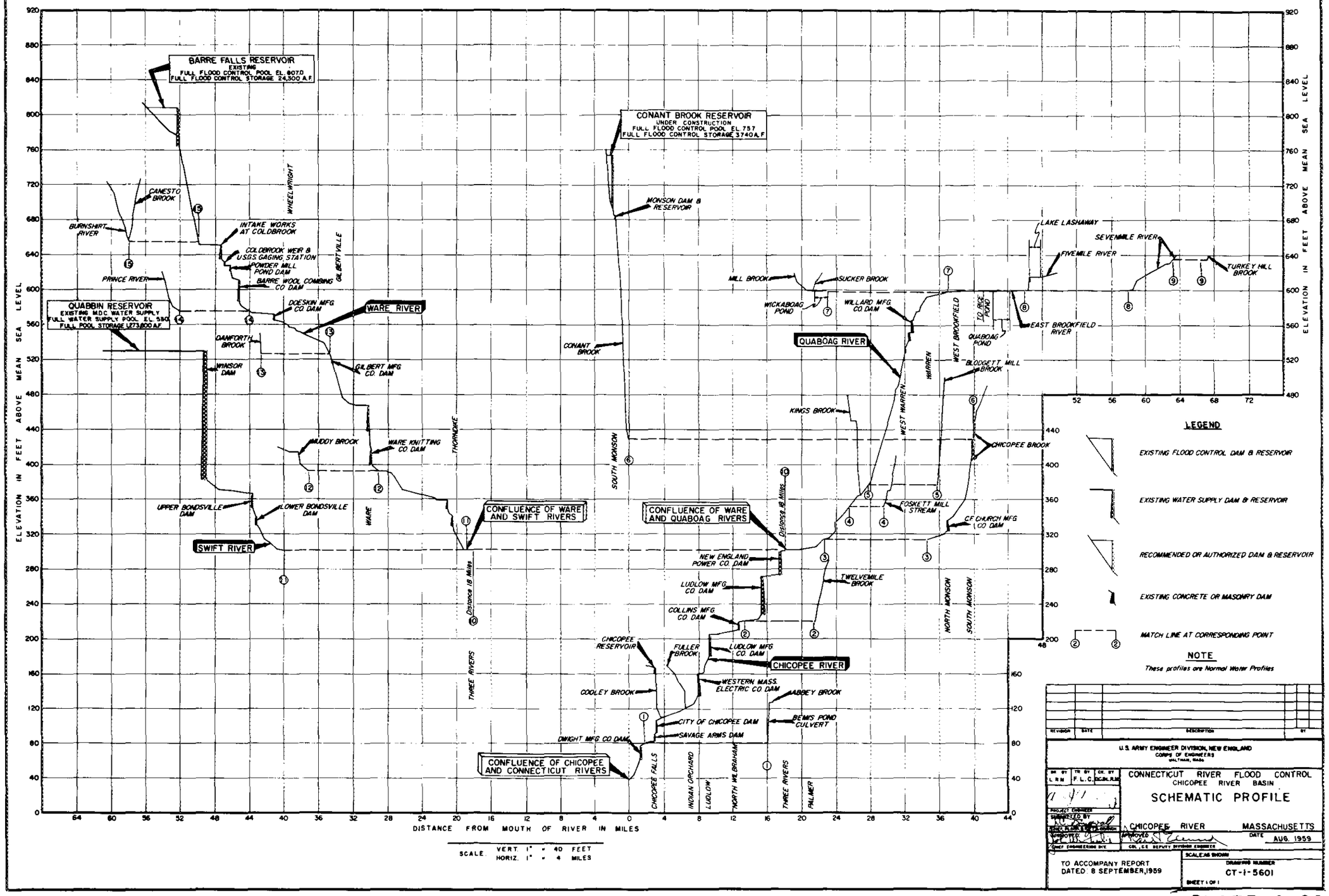
* Maintained By State Of Connecticut, Department of Environmental Protection, Water and Related Resources Unit.

ORGANIZATION CHART
RESERVOIR REGULATION

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.
JAN. 1979

PLATE G-25

CORPS OF ENGINEERS U. S. ARMY



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN
SCHEMATIC PROFILE
CHICOPEE RIVER MASSACHUSETTS
DATE AUG. 1959
SCALE AS SHOWN
DRAWING NUMBER CT-1-5601
SHEET 1 OF 1
TO ACCOMPANY REPORT DATED 8 SEPTEMBER, 1959

PLATE G-26

CORPS OF ENGINEERS

U. S. ARMY

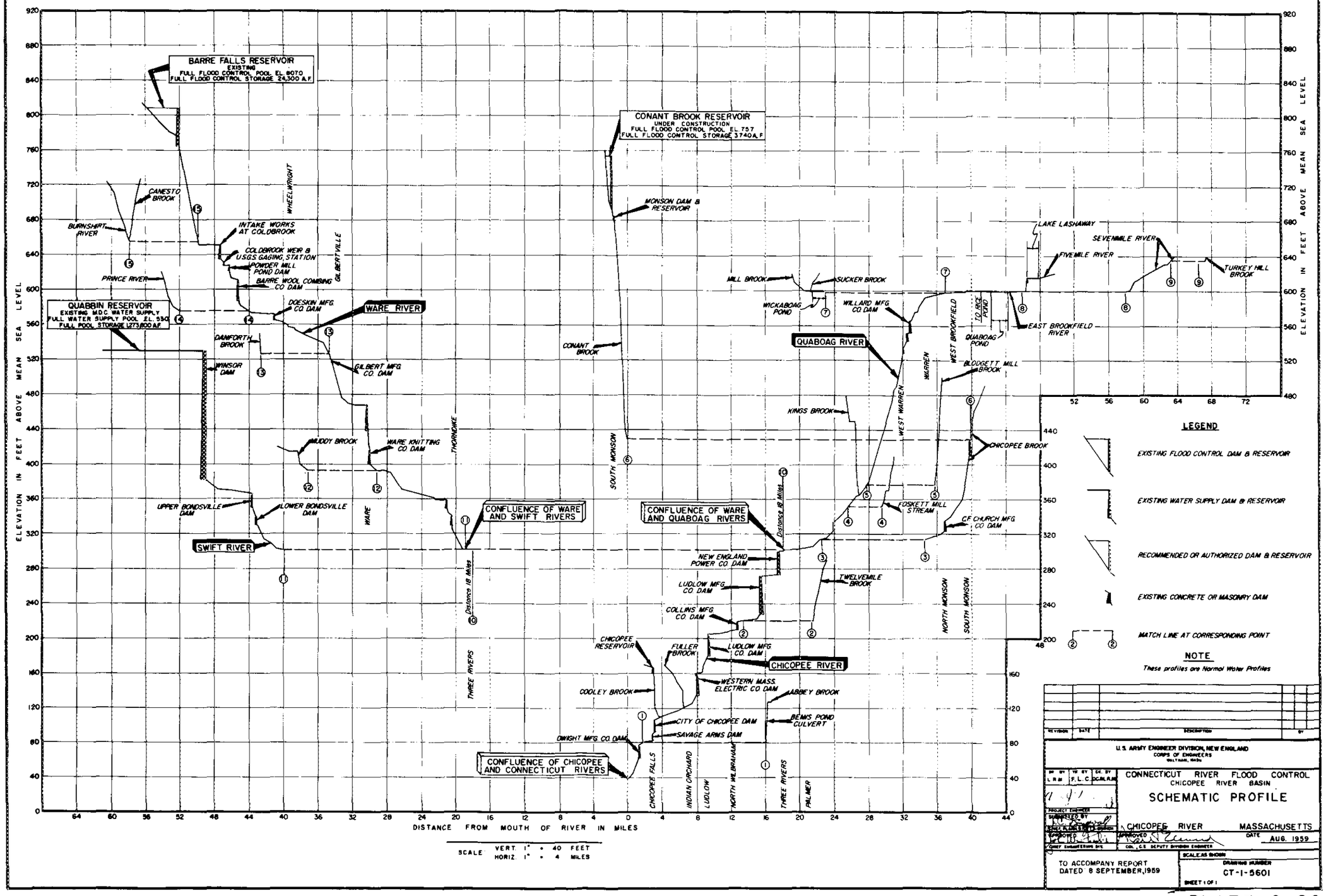
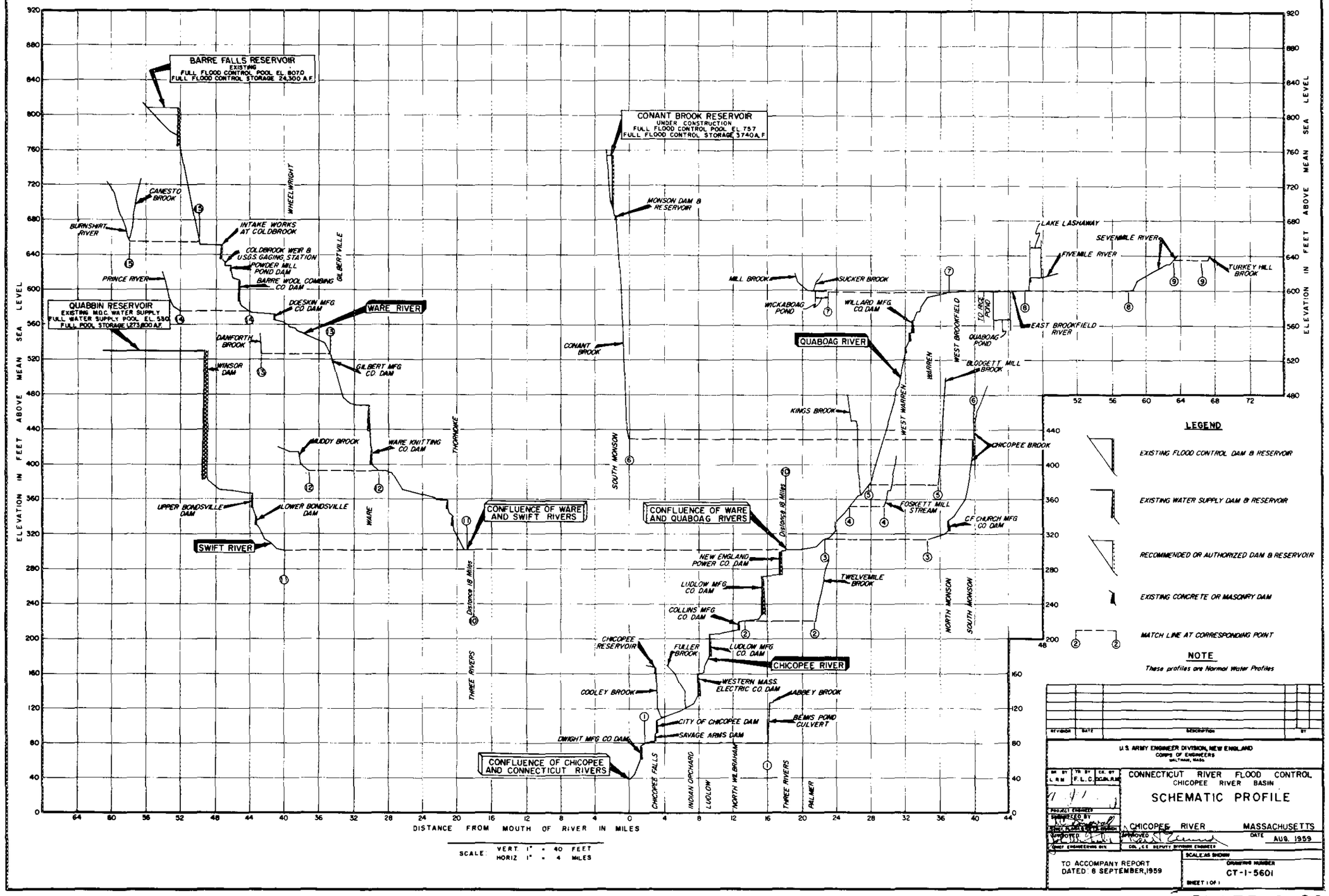


PLATE G-26

CORPS OF ENGINEERS

U. S. ARMY



LEGEND

EXISTING FLOOD CONTROL DAM & RESERVOIR

EXISTING WATER SUPPLY DAM & RESERVOIR

RECOMMENDED OR AUTHORIZED DAM & RESERVOIR

EXISTING CONCRETE OR MASONRY DAM

MATCH LINE AT CORRESPONDING POINT

NOTE

These profiles are Normal Water Profiles

BY	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY L.R.M. | TR. BY F.L.C. | CK. BY

PROJECT ENGINEER

DESIGNED BY

DRAWN

TRACED

CHECKED

APPROVED

CHIEF ENGINEERING DIV.

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN
SCHEMATIC PROFILE
CHICOPEE RIVER MASSACHUSETTS

DATE AUG. 1959

COL., C.E. DEPUTY DIVISION ENGINEER

TO ACCOMPANY REPORT DATED: 8 SEPTEMBER, 1959

SCALE AS SHOWN

DRAWING NUMBER
CT-1-5601

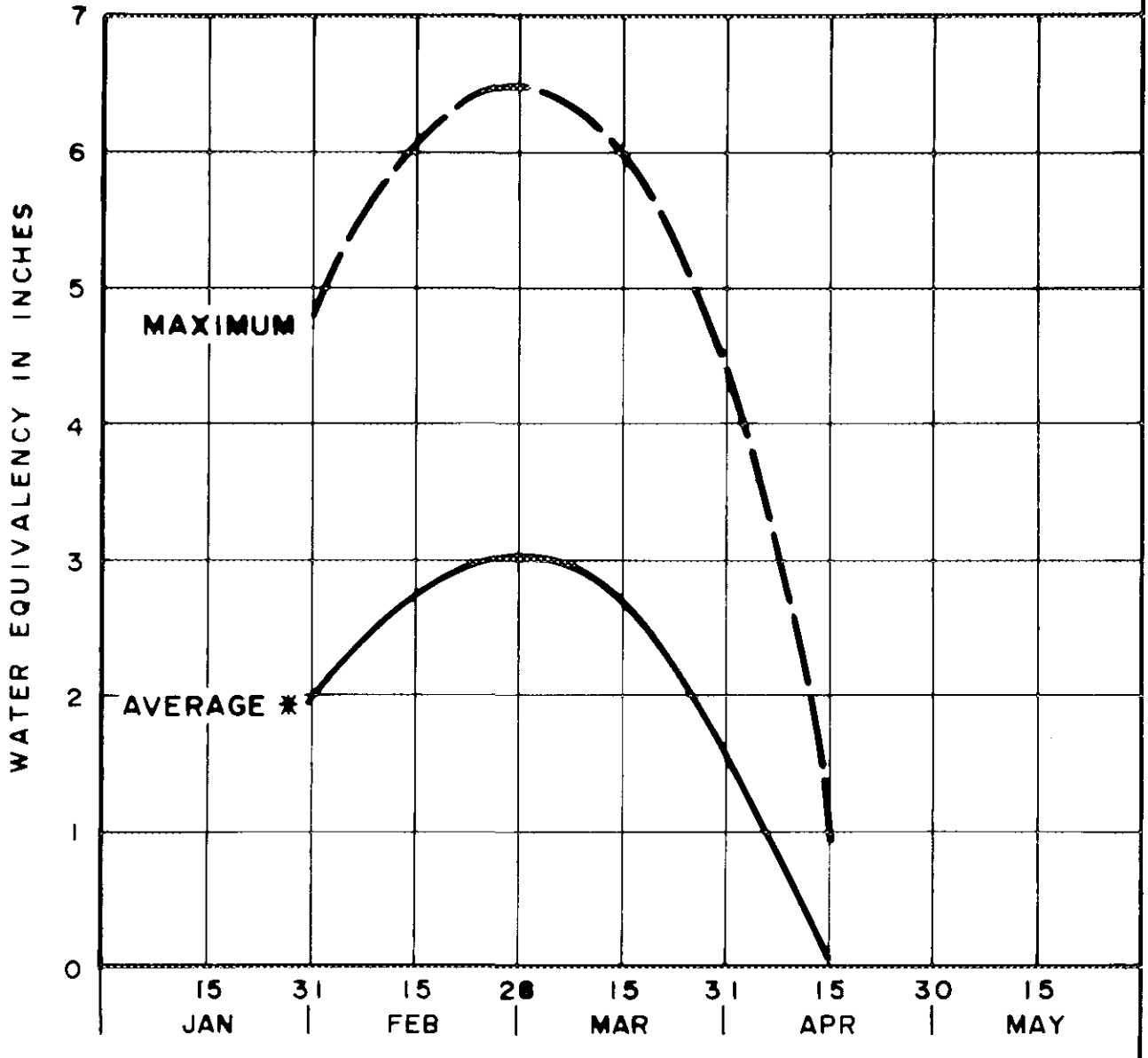
SHEET 1 OF 1

PLATE G-26

ANNUAL PRECIPITATION
CHICOPEE RIVER WATERSHED
(DEPTH IN INCHES)

Calendar Year	Ware, Mass. (Elevation 410 ft. msl) 1920-1976	Hardwick, Mass. (Elevation 990 ft. msl) 1920-1976	Southbridge, Mass. (Elevation 740 ft. msl) 1912-1978
1911			
1912			47.3
1913			44.5
1914			33.2
1915			42.3
1916			39.8
1917			36.5
1918			40.7
1919			59.4
1920	52.8		56.4
1921	42.0	48.9	42.8
1922	45.4	46.4	49.2
1923	46.2	42.5	44.6
1924	32.3	40.0	38.4
1925	39.0	41.2	40.6
1926	33.9	37.1	43.3
1927	52.3	53.1	50.9
1928	37.0	42.4	42.0
1929	40.5	36.8	40.7
1930	30.9	32.2	31.4
1931	-	42.0	40.8
1932	-	42.2	49.8
1933	-	50.6	55.9
1934	-	50.4	52.8
1935	-	40.0	40.9
1936	-	57.7	57.4
1937	-	53.2	58.6
1938	56.0	60.0	67.4(a)
1939	36.4	-	49.0
1940	45.5	42.7	49.4
1941	34.3	31.7	40.1
1942	46.6	44.6	49.5
1943	43.6	39.9	41.2
1944	41.9	-	44.2
1945	54.4	51.0	46.9
1946	40.6	-	45.5
1947	-	-	43.4
1948	45.4	46.4	46.6
1949	-	35.2	34.6
1950	-	42.2	47.0
1951	46.8	-	52.0
1952	40.9	40.7	49.2
1953	53.3	48.3	58.2
1954	53.6	48.6	56.2
1955	60.0(a)	54.3	60.6
1956	36.6	41.2	41.9
1957	32.0	34.6	34.9
1958	43.5	45.8	54.2
1959	48.6	52.2	55.1
1960	48.0	48.6	52.0
1961	38.8	44.9	44.7
1962	37.0	38.7	46.5
1963	36.4	36.7	40.5
1964	31.4	31.2	36.9
1965	26.4(b)	30.5(b)	32.1(b)
1966	34.9	36.2	43.6
1967	43.5	46.2	49.3
1968	39.0	40.0	46.3
1969	46.2	46.6	53.9
1970	41.9	43.0	45.0
1971	41.2	43.4	45.1
1972	57.8	55.1	65.0
1973	51.0	51.0	55.1
1974	52.8	49.2	55.0
1975	52.4	58.4	55.5
1976	41.6	44.7	46.4
Mean	44.6	44.9	46.4

(a) Maximum annual precipitation
(b) Minimum annual precipitation



* PERIOD OF RECORD: 1957 - 1978

NOTE:
MINIMUM WATER EQUIVALENT = 0.0

WATER RESOURCES DEVELOPMENT PROJECT

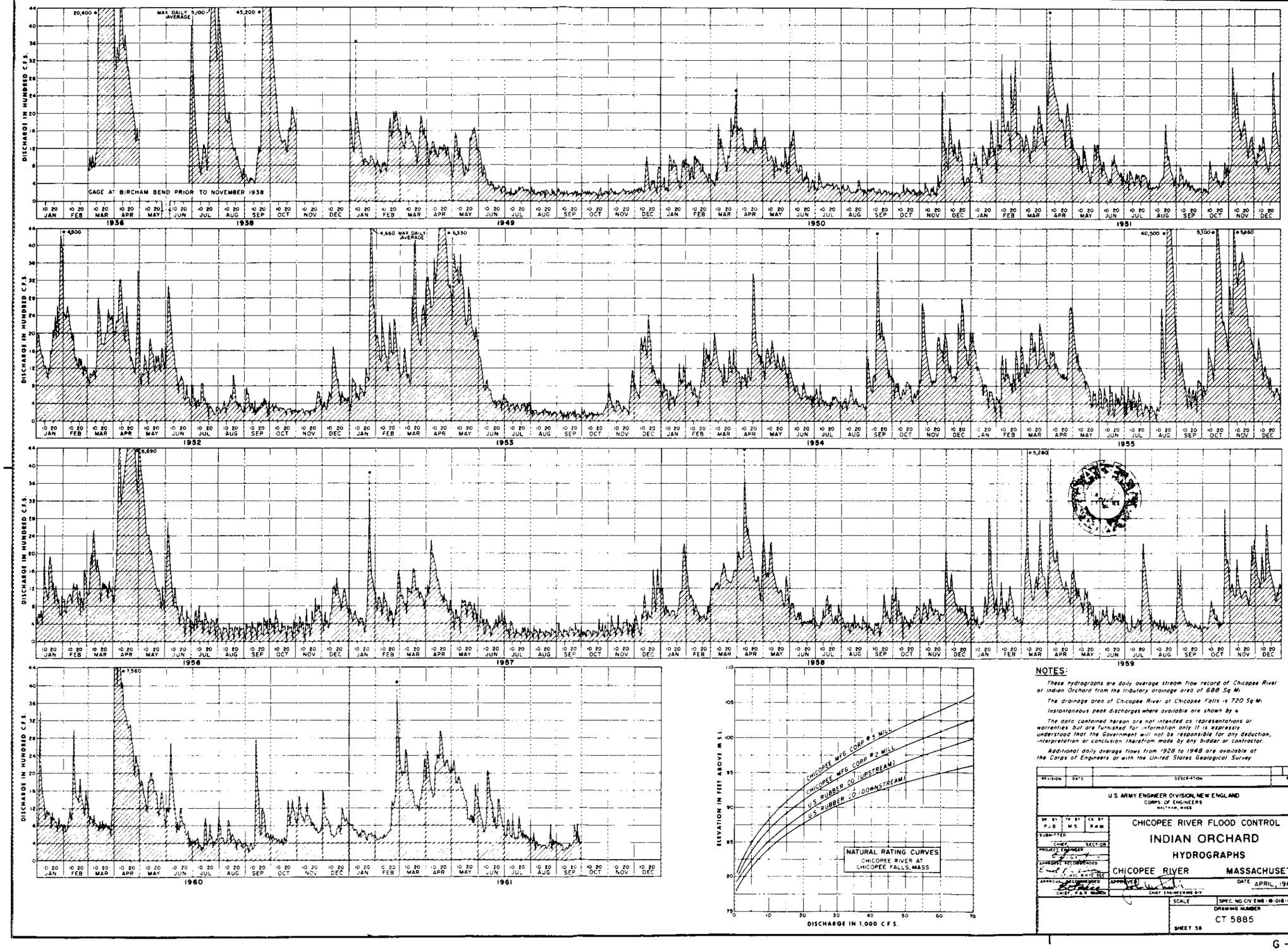
CONNECTICUT RIVER BASIN
CHICOPEE RIVER WATERSHED
WATER EQUIVALENT OF SNOW COVER

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-28

CORPS OF ENGINEERS

U. S. ARMY



NOTES:

These hydrographs are daily average stream flow record of Chicopee River at Indian Orchard from the tributary drainage area of 688 Sq Mi.

The drainage area of Chicopee River at Chicopee Falls is 720 Sq Mi.

Instantaneous peak discharges where available are shown by ●.

The data contained hereon are not intended as representations or warranties but are furnished for information only It is expressly understood that the Government will not be responsible for any deduction, interpretation or conclusion therefrom made by any bidder or contractor.

Additional daily average flows from 1928 to 1948 are available at the Corps of Engineers or with the United States Geological Survey

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR BY	TR BY	CK BY
PJB	MS	RWM

SUBMITTED
CHIEF SECTION
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF ENG. DIV.
APPROVAL RECOMMENDED
CHIEF P & P BRANCH
APPROVED
CHIEF ENGINEERING DIV.

CHICOPEE RIVER FLOOD CONTROL

INDIAN ORCHARD

HYDROGRAPHS

CHICOPEE RIVER MASSACHUSETTS

DATE APRIL, 1963

SCALE

SPEC. NO. CIV ENG-8-018-63-62

DRAWING NUMBER

CT 5885

SHEET 58

ANNUAL RUNOFF
CHICOPEE RIVER WATERSHED

Water Year	Ware River at Barre, Mass. D.A. = 55 sq. mi. 1946-1977		Ware River at Gibbs Crossing D.A. = 199 sq. mi. 1912-1977		Quaboag River at W. Brimfield, Mass. D.A. = 151 sq. mi. 1913-1977		Chicopee River at Indian Orchard D.A. = 688 sq. mi. 1928-1977	
	CFS	Inches	CFS	Inches	CFS	Inches	CFS	Inches
1913			259	17.6				
1914			315	21.5	233	21.0		
1915			207	14.1	171	15.4		
1916			407	27.8	298	26.8		
1917			300	20.5	219	19.7		
1918			245	16.7	178	16.0		
1919			354	24.2	252	22.7		
1920			423	20.9	362	32.6		
1921			379	25.9	276	24.8		
1922			394	26.9	267	24.0		
1923			307	21.0	257	23.1		
1924			314	21.4	276	24.8		
1925			206	14.1	148	13.3		
1926			282	19.3	171	15.4		
1927			314	21.4	206	18.5		
1928			461	31.5	339	30.5		
1929			311	21.2	228	20.5	1099	21.7
1930			161	11.0	104(b)	9.4(b)	589	11.6
1931			175	11.9	161	14.5	684	13.5
1932			192	13.1	169	15.2	764	15.1
1933			378	25.8	293	26.4	1287	25.4
1934			343	23.4	264	23.8	1234	24.4
1935			351	24.0	275	24.7	1215	24.0
1936			347	23.7	272	24.5	1213	24.0
1937			380	25.9	268	24.1	1345	26.6
1938			581(a)	39.7(a)	430(a)	38.7(a)	1952(a)	38.6(a)
1939			363	24.8	273	24.6	1287	25.4
1940			216	14.7	241	21.7	725	14.3
1941			164	11.2	131	11.8	460	9.1
1942			191	13.0	170	15.3	549	10.8
1943			256	17.5	256	23.0	823	16.3
1944			214	14.4	179	16.1	599	11.8
1945			307	21.0	282	25.4	867	17.1
1946			259	17.7	244	22.0	746	14.7
1947	82.8	20.4	259	17.7	224	20.1	765	15.1
1948	99.6	24.6	297	20.3	279	25.1	997	19.7
1949	74.7	18.4	240	16.4	171	15.3	701	13.8
1950	65.6	16.2	200	13.7	155	13.9	605	11.9
1951	96.6	23.8	291	19.9	254	22.8	927	18.3
1952	116	28.6	400	27.3	322	29.0	1241	24.5
1953	112	27.6	334	22.8	306	27.5	1156	22.8
1954	104	25.7	295	20.1	254	22.8	881	17.4
1955	101	24.9	407	27.8	400	36.0	1259	24.9
1956	133	32.8	466	31.8	357	32.1	1483	29.3
1957	61.2	15.1	213	14.5	155	13.9	624	12.3
1958	101	24.9	248	16.9	260	23.4	826	16.3
1959	85.6	21.1	263	18.0	241	21.7	831	16.4
1960	124	30.6	397	27.1	311	28.0	1224	24.2
1961	95.4	23.6	303	20.7	251	22.6	1007	19.9
1962	75.2	18.6	207	14.1	187	16.8	677	13.4
1963	73.2	18.1	205	14.0	215	19.3	648	12.8
1964	64.3	15.9	167	11.4	173	15.6	555	11.0
1965	29.5(b)	7.3(b)	107(b)	7.3(b)	104(b)	9.4(b)	396	7.8
1966	36.5	9.0	122	8.3	108	9.7	376(b)	7.4(b)
1967	82.9	20.5	245	16.7	223	20.1	684	13.5
1968	88.0	21.7	242	16.5	223	20.1	712	14.1
1969	87.3	21.6	209	14.3	213	19.2	665	13.1
1970	105	25.9	266	10.2	287	25.8	922	18.2
1971	65.8	16.2	200	13.7	179	16.1	601	11.9
1972	126	31.1	327	22.3	352	31.7	1049	20.7
1973	132(a)	32.6(a)	319	21.8	333	30.0	1066	21.0
1974	96.5	23.8	257	17.5	257	23.1	842	16.6
1975	106	26.2	292	19.9	284	25.6	953	18.8
1976	119	29.4	384	26.2	317	28.5	1165	23.0
1977	73.3	18.1	210	14.3	197	17.7	648	12.8
Average	90.5	22.4	288	19.7	241	21.7	896	17.7

(a) Maximum Annual Runoff
(b) Minimum Annual Runoff

PLATE G-30

9-310
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 01170500

Table No. (

Begin ____ YR. ____ MO. ____ D. ____ HR

Rating table for Connecticut River at Montague City

from _____ *to* _____, *from* _____ *to* _____, *from* _____ *to* _____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
3.00			5.00	1100	100	7.00	3620	150	9.00	7240	210	11.00	12000	250	13.00	17,800	320	15.00	24,200	320
.10			.10	1200	100	.10	3770	150	.10	7450	210	.10	12250	250	.10	18,120		.10	24,520	
.20			.20	1300	110	.20	3920	160	.20	7660	220	.20	12500	250	.20	18,440		.20	24,840	
.30			.30	1410	110	.30	4080	160	.30	7880	230	.30	12750	270	.30	18,760		.30	25,160	
.40			.40	1520	120	.40	4240	170	.40	8110		.40	13020	280	.40	19,080		.40	25,480	
.50			.50	1640	120	.50	4410	170	.50	8340		.50	13300	300	.50	19,400		.50	25,800	
.60			.60	1760	120	.60	4580	180	.60	8570		.60	13600		.60	19,720		.60	26,120	
.70	205	40	.70	1880	120	.70	4760		.70	8800		.70	13900		.70	20,040		.70	26,440	
.80	245	45	.80	2000	130	.80	4940		.80	9030	230	.80	14200		.80	20,360		.80	26,760	
.90	290	50	.90	2130	130	.90	5120		.90	9260	240	.90	14500		.90	20,680		.90	27,080	
4.00	340	55	6.00	2260	130	8.00	5300	180	10.00	9500	250	12.00	14800		14.00	21,000		16.00	27,400	
.10	395	60	.10	2390	130	.10	5480		.10	9750		.10	15100		.10	21,320		.10	27,720	
.20	455	65	.20	2520	130	.20	5670		.20	10000		.20	15400		.20	21,640		.20	28,040	
.30	520	70	.30	2650	130	.30	5860		.30	10250		.30	15700		.30	21,960		.30	28,360	
.40	590	70	.40	2780	130	.40	6050	190	.40	10500		.40	16000		.40	22,280		.40	28,680	
.50	660	80	.50	2910	140	.50	6240	200	.50	10750		.50	16300		.50	22,600		.50	29,000	
.60	740	80	.60	3050	140	.60	6440		.60	11000		.60	16600		.60	22,920		.60	29,320	
.70	820	90	.70	3190	140	.70	6640		.70	11250		.70	16900		.70	23,240		.70	29,640	
.80	910	90	.80	3330	140	.80	6840		.80	11500		.80	17200		.80	23,560		.80	29,960	
.90	1000	100	.90	3470	150	.90	7040	200	.90	11750	250	.90	17500	300	.90	23,880	320	.90	30,280	320

PLATE G-310

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during _____

_____ and is _____ well defined between _____ cfs and _____ cfs.

Comp. by _____ date _____

Chd. by _____ date _____

U.S. GOVERNMENT PRINTING OFFICE : 1967 O—300-763

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 0 1 1 7 0 5 0 0
Table No. _ _
Begin _ _ _ _ _ _ _ _
YR. MO. D. HR

Rating table for Connecticut River at Montague City

from _____ *to* _____, *from* _____ *to* _____, *from* _____ *to* _____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
3.00			5.00	1100	100	7.00	3620	150	9.00	7240	210	11.00	12000	250	13.00	17,800	320	15.00	24,200	320
.10			.10	1200	100	.10	3770	150	.10	7450	210	.10	12250	250	.10	18,120		.10	24,520	
.20			.20	1300	110	.20	3920	160	.20	7660	220	.20	12500	250	.20	18,440		.20	24,840	
.30			.30	1410	110	.30	4080	160	.30	7880	230	.30	12750	270	.30	18,760		.30	25,160	
.40			.40	1520	120	.40	4240	170	.40	8110		.40	13020	280	.40	19,080		.40	25,480	
.50			.50	1640	120	.50	4410	170	.50	8340		.50	13300	300	.50	19,400		.50	25,800	
.60			.60	1760	120	.60	4580	180	.60	8570		.60	13600		.60	19,720		.60	26,120	
.70	205	40	.70	1880	120	.70	4760		.70	8800		.70	13900		.70	20,040		.70	26,440	
.80	245	45	.80	2000	130	.80	4940		.80	9030	230	.80	14200		.80	20,360		.80	26,760	
.90	290	50	.90	2130	130	.90	5120		.90	9260	240	.90	14500		.90	20,680		.90	27,080	
4.00	340	55	6.00	2260	130	8.00	5300	180	10.00	9500	250	12.00	14800		14.00	21,000		16.00	27,400	
.10	395	60	.10	2390	130	.10	5480		.10	9750		.10	15100		.10	21,320		.10	27,720	
.20	455	65	.20	2520	130	.20	5670		.20	10000		.20	15400		.20	21,640		.20	28,040	
.30	520	70	.30	2650	130	.30	5860		.30	10250		.30	15700		.30	21,960		.30	28,360	
.40	590	70	.40	2780	130	.40	6050	190	.40	10500		.40	16000		.40	22,280		.40	28,680	
.50	660	80	.50	2910	140	.50	6240	200	.50	10750		.50	16300		.50	22,600		.50	29,000	
.60	740	80	.60	3050	140	.60	6440		.60	11000		.60	16600		.60	22,920		.60	29,320	
.70	820	90	.70	3190	140	.70	6640		.70	11250		.70	16900		.70	23,240		.70	29,640	
.80	910	90	.80	3330	140	.80	6840		.80	11500		.80	17200		.80	23,560		.80	29,960	
.90	1000	100	.90	3470	150	.90	7040	200	.90	11750	250	.90	17500	300	.90	23,880	320	.90	30,280	320

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during _____ and is _____ well defined between _____ cfs and _____ cfs.

Comp. by _____ date _____

Ckd. by _____ date _____

PLATE G-31a

U.S. GOVERNMENT PRINTING OFFICE : 1967 OF—300-765

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 0 1 1 7 0 5 0 0
Table No. _ _
Begin _ _ _ _ _ _ _ _
YR. MO. D. HR.

Rating table for Connecticut River at Montague City

from _____ *to* _____, *from* _____ *to* _____; *from* _____ *to* _____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
3.00			5.00	1100	100	7.00	3620	150	9.00	7240	210	11.00	12000	250	13.00	17,800	320	15.00	24,200	320
.10			.10	1200	100	.10	3770	150	.10	7450	210	.10	12250	250	.10	18,120		.10	24,520	
.20			.20	1300	110	.20	3920	160	.20	7660	220	.20	12500	250	.20	18,440		.20	24,840	
.30			.30	1410	110	.30	4080	160	.30	7880	230	.30	12750	270	.30	18,760		.30	25,160	
.40			.40	1520	120	.40	4240	170	.40	8110		.40	13020	280	.40	19,080		.40	25,480	
.50			.50	1640	120	.50	4410	170	.50	8340		.50	13300	300	.50	19,400		.50	25,800	
.60			.60	1760	120	.60	4580	180	.60	8570		.60	13600		.60	19,720		.60	26,120	
.70	205	40	.70	1880	120	.70	4760		.70	8800		.70	13900		.70	20,040		.70	26,440	
.80	245	45	.80	2000	130	.80	4940		.80	9030	230	.80	14200		.80	20,360		.80	26,760	
.90	290	50	.90	2130	130	.90	5120		.90	9260	240	.90	14500		.90	20,680		.90	27,080	
4.00	340	55	6.00	2260	130	8.00	5300	180	10.00	9500	250	12.00	14800		14.00	21,000		16.00	27,400	
.10	395	60	.10	2390	130	.10	5480		.10	9750		.10	15100		.10	21,320		.10	27,720	
.20	455	65	.20	2520	130	.20	5670		.20	10000		.20	15400		.20	21,640		.20	28,040	
.30	520	70	.30	2650	130	.30	5860		.30	10250		.30	15700		.30	21,960		.30	28,360	
.40	590	70	.40	2780	130	.40	6050	190	.40	10500		.40	16000		.40	22,280		.40	28,680	
.50	660	80	.50	2910	140	.50	6240	200	.50	10750		.50	16300		.50	22,600		.50	29,000	
.60	740	80	.60	3050	140	.60	6440		.60	11000		.60	16600		.60	22,920		.60	29,320	
.70	820	90	.70	3190	140	.70	6640		.70	11250		.70	16900		.70	23,240		.70	29,640	
.80	910	90	.80	3330	140	.80	6840		.80	11500		.80	17200		.80	23,560		.80	29,960	
.90	1000	100	.90	3470	150	.90	7040	200	.90	11750	250	.90	17500	300	.90	23,880	320	.90	30,280	320

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during _____ and is _____ well defined between _____ cfs and _____ cfs.

Comp. by _____ date _____

Ckd. by _____ date _____

PLATE G-31a

U.S. GOVERNMENT PRINTING OFFICE : 1967 OF—300-763

9-21
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 01 70 00
Table No. 20
Begin 66 1 00 1 (YR. MO. D. HR.)

Rating table for Connecticut River at Montague City, Mass.
from October 1, 1966 *to* , *from* *to* , *from* *to*

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
17.00	30600	360	19.00	39000	380	21.00	46800	400	23.00	55000	440	25.00	64000	480	27.00	73800	520	29.00	84200	540
.10	30960	360	.10	39380	380	.10	47200	400	.10	55440	440	.10	64480	480	.10	74320	520	.10	84740	540
.20	31320	360	.20	39760	380	.20	47600	400	.20	55880	440	.20	64960	480	.20	74840	520	.20	85280	540
.30	31680	360	.30	40140	380	.30	48000	400	.30	56320	440	.30	65440	480	.30	75360	520	.30	85820	540
.40	32040	360	.40	40520	380	.40	48400	400	.40	56760	440	.40	65920	480	.40	75880	520	.40	86360	540
.50	32400	360	.50	40900	380	.50	48800	400	.50	57200	440	.50	66400	480	.50	76400	520	.50	86900	540
.60	32760	360	.60	41280	380	.60	49200	400	.60	57640	440	.60	66880	480	.60	76920	520	.60	87440	540
.70	33120	360	.70	41660	380	.70	49600	400	.70	58080	440	.70	67360	480	.70	77440	520	.70	87980	540
.80	33480	360	.80	42040	380	.80	50000	400	.80	58520	440	.80	67840	480	.80	77960	520	.80	88520	540
.90	33840	360	.90	42420	380	.90	50400	400	.90	59660	440	.90	68320	480	.90	78480	520	.90	89060	540
18.00	35200	380	20.00	42800	400	22.00	50800	420	24.00	59400	460	26.00	68800	500	28.00	79000	520	30.00	89600	540
.10	35580	380	.10	43200	400	.10	51220	420	.10	59860	460	.10	69300	500	.10	79520	520	.10	90140	540
.20	35960	380	.20	43600	400	.20	51640	420	.20	60320	460	.20	69800	500	.20	80040	520	.20	90680	540
.30	36340	380	.30	44000	400	.30	52060	420	.30	60780	460	.30	70300	500	.30	80560	520	.30	91220	540
.40	36720	380	.40	44400	400	.40	52480	420	.40	61240	460	.40	70800	500	.40	81080	520	.40	91760	540
.50	37100	380	.50	44800	400	.50	52900	420	.50	61700	460	.50	71300	500	.50	81600	520	.50	92300	540
.60	37480	380	.60	45200	400	.60	53320	420	.60	62160	460	.60	71800	500	.60	82120	520	.60	92840	540
.70	37860	380	.70	45600	400	.70	53740	420	.70	62620	460	.70	72300	500	.70	82640	520	.70	93380	540
.80	38240	380	.80	46000	400	.80	54160	420	.80	63080	460	.80	72800	500	.80	83160	520	.80	93920	540
.90	38620	380	.90	46400	400	.90	54580	420	.90	63540	460	.90	73300	500	.90	83680	520	.90	94460	540

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during
It is identical with rating 19 above and is _____ well defined between 5,000 cfs and 150,000 cfs.
6.0 feet

Comp. by RAG date 12-8-70
Ckd. by JWB date 12-17-70

U.S. GOVERNMENT PRINTING OFFICE : 1967 OF—249-768

PLATE G-31b

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 01165000

Table No. 20

Begin 35 10 01 __
YR. MO. D. HR.

Rating table for Connecticut River at Montague City, Mass.

from October 1, 1935 *to* ____, *from* ____ *to* ____, *from* ____ *to* ____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*
31.00	95000	550	33.00	106500	650	35.00	120000	700	37.00	134000	700	39.00	149000	800	41.00	165000	800	43.00	181000	800
.10	95550	550	.10	107150	650	.10	120700	700	.10	134700	700	.10	149800	800	.10	165800	800	.10	181800	800
.20	96100	550	.20	107800	650	.20	121400	700	.20	135400	700	.20	150600	800	.20	166600	800	.20	182600	800
.30	96650	550	.30	108450	650	.30	122100	700	.30	136100	700	.30	151400	800	.30	167400	800	.30	183400	800
.40	97200	550	.40	109100	650	.40	122800	700	.40	136800	700	.40	152200	800	.40	168200	800	.40	184200	800
.50	97750	550	.50	109750	650	.50	123500	700	.50	137500	700	.50	153000	800	.50	169000	800	.50	185000	800
.60	98300	550	.60	110400	650	.60	124200	700	.60	138200	700	.60	153800	800	.60	169800	800	.60	185800	800
.70	98850	550	.70	111050	650	.70	124900	700	.70	138900	700	.70	154600	800	.70	170600	800	.70	186600	800
.80	99400	550	.80	111700	650	.80	125600	700	.80	139600	700	.80	155400	800	.80	171400	800	.80	187400	800
.90	99950	550	.90	112350	650	.90	126300	700	.90	140300	700	.90	156200	800	.90	172200	800	.90	188200	800
32.00	100500	600	34.00	113000	700	36.00	127000	700	38.00	141000	800	40.00	157000	800	42.00	173000	800	44.00	189000	800
.10	101100	600	.10	113700	700	.10	127700	700	.10	141800	800	.10	157800	800	.10	173800	800	.10	189800	800
.20	101700	600	.20	114400	700	.20	128400	700	.20	142600	800	.20	158600	800	.20	174600	800	.20	190600	800
.30	102300	600	.30	115100	700	.30	129100	700	.30	143400	800	.30	159400	800	.30	175400	800	.30	191400	800
.40	102900	600	.40	11580	700	.40	129800	700	.40	144200	800	.40	160200	800	.40	176200	800	.40	192200	800
.50	103500	600	.50	116500	700	.50	130500	700	.50	145000	800	.50	161000	800	.50	177000	800	.50	193000	800
.60	104100	600	.60	117200	700	.60	131200	700	.60	145800	800	.60	161800	800	.60	177800	800	.60	193800	800
.70	104700	600	.70	117900	700	.70	131900	700	.70	146600	800	.70	162600	800	.70	178600	800	.70	194600	800
.80	105300	600	.80	118600	700	.80	132600	700	.80	147400	800	.80	163400	800	.80	179400	800	.80	195400	800
.90	105900	600	.90	119300	700	.90	133300	700	.90	148200	800	.90	164200	800	.90	180200	800	.90	196200	800

This table is applicable for open-channel conditions. It is based on ____ discharge measurements made during ____

It is identical with rating 19 above and is ____ well defined between 5,000 cfs and 150,000 cfs.

6.0 feet.

Comp. by RAG date 12-8-70

Ckd. by JWB date 12-17-70

PLATE G-31c

U.S. GOVERNMENT PRINTING OFFICE : 1967 O—240-765

CONNECTICUT RIVER
RATING TABLES

Gage (ft)	Holyoke, Mass.[1] (DA = 8,177 sq. mi.) Zero Datum 97.47 ft msl	Springfield, Mass.[2] (DA = 9,587 sq. mi.) Zero Datum 37.76 ft msl	Hartford, Conn.[3] (DA = 10,428 sq. mi.) Zero Datum 0.55 ft msl
0	0	0	0
1	4,000	1,500	2,000
2	9,000	3,000	4,000
3	16,000	6,000	6,500
4	24,000	11,000	9,500
5	35,000	16,000	12,500
6	46,000	22,000	15,800
7	60,000	28,000	19,600
8	74,000	35,000	23,400
9	90,000	42,000	27,600
10	105,000	50,000	32,000
11	124,000	58,000	37,000
12	143,000	66,000	42,000
13	162,000	74,000	47,000
14	182,000	82,000	53,000
15	203,000	94,000	59,500
16	226,000	104,000	66,000
17		114,000	72,500
18		126,000	80,000
19		138,000	87,500
20		151,000	95,000
21		166,000	104,000
22		180,000	113,500
23		194,000	123,500
24		210,000	133,500
25		225,000	143,500
26		240,000	153,500
27		257,000	163,500
28		274,000	173,700
29			184,000
30			194,500
31			205,000
32			215,500
33			226,000
34			237,000

(1) gage located at Holyoke Water Power Company Dam.
(2) gage located at York Street Pumping Station.
(3) gage located at Buckley Bridge.

9-210
(Rev. 2)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 0118 '98
Table No. 29
Begin 671001 (YR. MO. D HR.)

Rating table for Connecticut River at Thompsonville, Conn.

from Oct. 1970 *to* ____, *from* ____ *to* ____, *from* ____ *to* ____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
0.00			2.00	12800	1100	4.00	43000	1800	6.00	80000	1900	8.00	118000	1900	10.00	156000	1900	12.00	194000	1900
.10			.10	13900	1100	.10	44800		.10	81900		.10	119900		.10	157900		.10	195900	
.20			.20	15000	1100	.20	46600		.20	83800		.20	121800		.20	159800		.20	197800	
.30			.30	16100	1200	.30	48400		.30	85700		.30	123700		.30	161700		.30	199700	
.40			.40	17300	1200	.40	50200		.40	87600		.40	125600		.40	163600		.40	201600	
.50			.50	18500	1300	.50	52000		.50	89500		.50	127500		.50	165500		.50	203500	
.60			.60	19800	1300	.60	53800		.60	91400		.60	129400		.60	167400		.60	205400	
.70			.70	21100	1400	.70	55600		.70	93300		.70	131300		.70	169300		.70	207300	
.80			.80	22500	1400	.80	57400		.80	95200		.80	133200		.80	171200		.80	209200	
.90			.90	23900	1500	.90	59200	1800	.90	97100		.90	135100		.90	173100		.90	211100	
1.00			3.00	25400	1600	5.00	61000	1900	7.00	99000		9.00	137000		11.00	175000		13.00	213000	
.10			.10	27000	1700	.10	62900		.10	100900		.10	138900		.10	176900		.10	214900	
.20			.20	28700	1700	.20	64800		.20	102800		.20	140800		.20	178800		.20	216800	
.30	6420	780	.30	30400	1800	.30	66700		.30	104700		.30	142700		.30	180700		.30	218700	
.40	7200	850	.40	32200		.40	68600		.40	106600		.40	144600		.40	182600		.40	220600	
.50	8050	900	.50	34000		.50	70500		.50	108500		.50	146500		.50	184500		.50	222500	
.60	8950	900	.60	35800		.60	72400		.60	110400		.60	148400		.60	186400		.60	224400	
.70	9850	950	.70	37600		.70	74300		.70	112300		.70	150300		.70	188300		.70	226300	
.80	10100	1000	.80	39400		.80	76200		.80	114200		.80	152200		.80	190200		.80	228200	
.90	11800	1000	.90	41200	1800	.90	78100	1900	.90	116100	1900	.90	154100	1900	.90	192100	1900	.90	230100	1900

This table is applicable for open-channel conditions. It is based on ____ discharge measurements made during ____ and is ____ well defined between ____ cfs and ____ cfs.

Comp. by ____ date ____

Ckd. by ____ date ____

PLATE G-33 a

U.S. GOVERNMENT PRINTING OFFICE : 1967 OP—245-765

(Rev. 9-)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. _ _(_ _ _ _ _
Table No. _ _
Begin _ _ _ _ _ _ _ _
YR. MO. D. HR.

Rating table for Connecticut River at Thompsonville, Connecticut

from _____ *to* _____, *from* _____ *to* _____, *from* _____ *to* _____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*
14.00	232000	1900	16.00	271000	2000	.00			.00			.00			.00			.00		
.10	233900		.10	273000		.10			.10			.10			.10			.10		
.20	235800		.20	275000		.20			.20			.20			.20			.20		
.30	237700		.30	277000		.30			.30			.30			.30			.30		
.40	249600		.40	279000		.40			.40			.40			.40			.40		
.50	241500		.50	281000		.50			.50			.50			.50			.50		
.60	243400		.60	283000	2000	.60			.60			.60			.60			.60		
.70	245300		.70			.70			.70			.70			.70			.70		
.80	247200		.80			.80			.80			.80			.80			.80		
.90	249100	1900	.90			.90			.90			.90			.90			.90		
15.00	251000	2000	.00			.00			.00			.00			.00			.00		
.10	253000		.10			.10			.10			.10			.10			.10		
.20	255000		.20			.20			.20			.20			.20			.20		
.30	257000		.30			.30			.30			.30			.30			.30		
.40	259000		.40			.40			.40			.40			.40			.40		
.50	261000		.50			.50			.50			.50			.50			.50		
.60	263000		.60			.60			.60			.60			.60			.60		
.70	265000		.70			.70			.70			.70			.70			.70		
.80	267000		.80			.80			.80			.80			.80			.80		
.90	269000	2000	.90			.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during _____

_____ and is _____ well defined between _____ cfs and _____ cfs.

Comp. by _____ date _____

Ckd. by _____ date _____

PLATE G-33b

U.S. GOVERNMENT PRINTING OFFICE : 1967 O—000-765

9-210
(Rev. 2-

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 01177000

Table No. __

Begin ____ ____ ____ ____ ____
YR. MO. D. HR.

Rating table for Chicopee River at Indian Orchard

from ____ *to* ____, *from* ____ *to* ____, *from* ____ *to* ____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*
1.00			3.00	27	8	5.00	660	65	7.00	2350	100	9.00	4720	140	11.00	7810	180	13.00	11890	240
.10			.10	35	9	.10	725	70	.10	2450	100	.10	4860	140	.10	7990	180	.10	12130	240
.20			.20	44	11	.20	795	70	.20	2550	110	.20	5000	140	.20	8170	180	.20	12370	240
.30			.30	55	13	.30	865	70	.30	2660	110	.30	5140	140	.30	8350	190	.30	12610	240
.40			.40	68	14	.40	935	70	.40	2770	110	.40	5280	140	.40	8540	190	.40	12850	250
.50			.50	82	16	.50	1005	70	.50	2880	110	.50	5420	140	.50	8730	190	.50	13100	250
.60			.60	98	18	.60	1080	80	.60	2990	110	.60	5560	150	.60	8920	190	.60	13350	250
.70			.70	116	21	.70	1160	80	.70	3100	110	.70	5710	150	.70	9110	200	.70	13600	250
.80			.80	137	24	.80	1240	80	.80	3210	120	.80	5860	150	.80	9310	200	.80	13850	250
.90			.90	161	27	.90	1320	90	.90	3330	120	.90	6010	150	.90	9510	200	.90	14100	260
2.00			4.00	188	31	6.00	1410	90	8.00	3450	120	10.00	6160	150	12.00	9710	200	14.00	14360	260
.10			.10	219	34	.10	1500	90	.10	3570	120	.10	6310	160	.10	9910	210	.10	14620	260
.20			.20	253	37	.20	1590	90	.20	3690	120	.20	6470	160	.20	10120	210	.20	14880	260
.30			.30	290	40	.30	1680	90	.30	3810	130	.30	6630	160	.30	10330	210	.30	15140	270
.40			.40	330	45	.40	1770	90	.40	3940	130	.40	6790	160	.40	10540	220	.40	15410	270
.50			.50	375	50	.50	1860	90	.50	4070	130	.50	6950	170	.50	10760	220	.50	15680	270
.60			.60	425	55	.60	1950	100	.60	4200	130	.60	7120	170	.60	10980	220	.60	15950	270
.70	10.5	4.5	.70	480	55	.70	2050	100	.70	4330	130	.70	7290	170	.70	11200	230	.70	16220	270
.80	15	5.5	.80	535	60	.80	2150	100	.80	4460	130	.80	7460	170	.80	11430	230	.80	16490	280
.90	20.5	6.5	.90	595	65	.90	2250	100	.90	4590	130	.90	7630	180	.90	11660	230	.90	16770	280

This table is applicable for open-channel conditions. It is based on ____ discharge measurements made during ____

____ and is ____ well defined between ____ cfs and ____ cfs.

Comp. by ____ date ____

Ckd. by ____ date ____

PLATE G-340

U.S. GOVERNMENT PRINTING OFFICE : 1967 OF—249-765

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 01172500
Table No. 25
Begin YR. MO. D. HR.

Rating table for Ware River at Barre

from ____ *to* ____, *from* ____ *to* ____, *from* ____ *to* ____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
2.00			4.00	283	37	6.00	1592	108	.00			.00			.00			.00		
.10	1.3	1.4	.10	320	37	.10	1700	112	.10			.10			.10			.10		
.20	2.7	2.0	.20	357	40	.20	1812	117	.20			.20			.20			.20		
.30	4.7	2.9	.30	397	43	.30	1929	121	.30			.30			.30			.30		
.40	7.6	4.0	.40	440	45	.40	2050		.40			.40			.40			.40		
.50	11.6	4.9	.50	485	49	.50			.50			.50			.50			.50		
.60	16.5	6.3	.60	534	51	.60			.60			.60			.60			.60		
.70	22.8	7.8	.70	585	55	.70			.70			.70			.70			.70		
.80	30.6	9.4	.80	640	58	.80			.80			.80			.80			.80		
.90	40.0	10.8	.90	698	62	.90			.90			.90			.90			.90		
3.00	50.8	12.6	5.00	760	66	.00			.00			.00			.00			.00		
.10	63.4	14.6	.10	826	70	.10			.10			.10			.10			.10		
.20	78.0	16.7	.20	896	74	.20			.20			.20			.20			.20		
.30	94.7	19.3	.30	970	76	.30			.30			.30			.30			.30		
.40	114	21	.40	1046	79	.40			.40			.40			.40			.40		
.50	135	24	.50	1125	84	.50			.50			.50			.50			.50		
.60	159	26	.60	1209	89	.60			.60			.60			.60			.60		
.70	185	29	.70	1298	92	.70			.70			.70			.70			.70		
.80	214	33	.80	1390	99	.80			.80			.80			.80			.80		
.90	247	36	.90	1489	103	.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on _____ discharge measurements made during _____ and is _____ well defined between _____ cfs and _____ cfs.

Comp. by _____ date _____

Ckd. by _____ date _____

PLATE G-35

U.S. GOVERNMENT PRINTING OFFICE : 1967 O—800-765

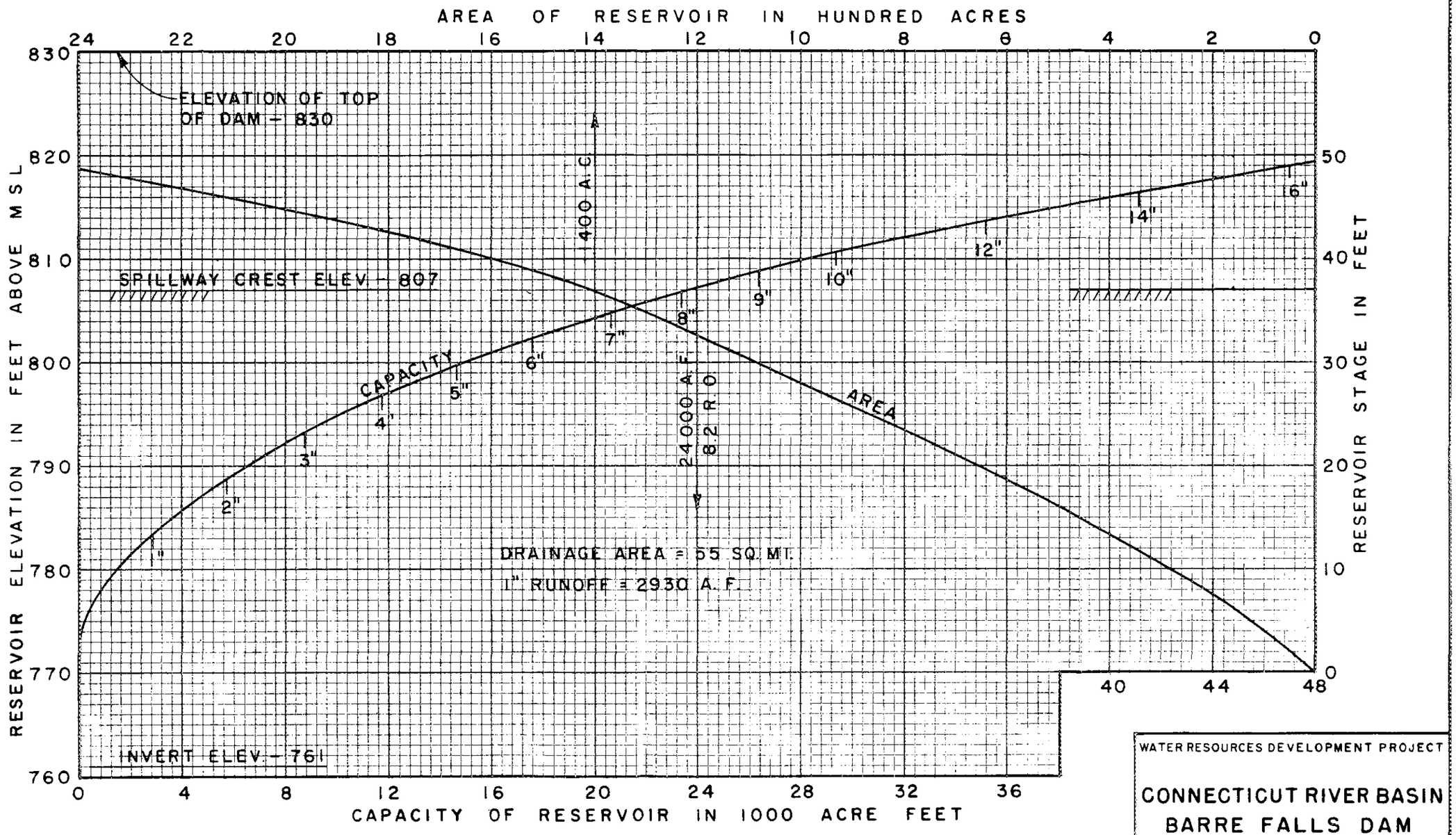
BARRE FALLS DAM
AREA AND CAPACITY

DRAINAGE AREA = 55 SQ.MI.

Elev. (msl)	Stage (ft)	Area (acres)	Capacity Ac-Feet	Capacity Inches
770	0	0	0	0.00
771	1	20	15	.01
772	2	50	60	.02
773	3	80	120	.04
774	4	100	220	.07
775	5	125	340	.12
776	6	160	490	.17
777	7	180	670	.23
778	8	215	880	.30
779	9	245	1120	.38
780	10	280	1390	.47
781	11	320	1700	.58
782	12	360	2050	.70
783	13	390	2430	.83
784	14	430	2850	.97
785	15	460	3300	1.12
786	16	500	3790	1.29
787	17	540	4320	1.47
788	18	580	4900	1.67
789	19	620	5510	1.88
790	20	660	6170	2.10
791	21	700	6870	2.34
792	22	740	7610	2.59
793	23	790	8410	2.86
794	24	830	9250	3.15
795	25	870	10100	3.44
796	26	920	11000	3.75
797	27	960	12000	4.09
798	28	1000	13000	4.46
799	29	1040	14100	4.80
800	30	1090	15200	5.18
801	31	1140	16300	5.55
802	32	1180	17500	5.96
803	33	1220	18700	6.37
804	34	1260	20000	6.81
805	35	1300	21300	7.26
806	36	1350	22600	7.70
807	37	1400	24000	8.20

Crest Elevation = 807

Invert Elevation = 761 due to 9 foot drop at inlet channel.



NOTE: INVERT ELEVATION = 761 DUE TO 9' DROP AT INLET CHANNEL.

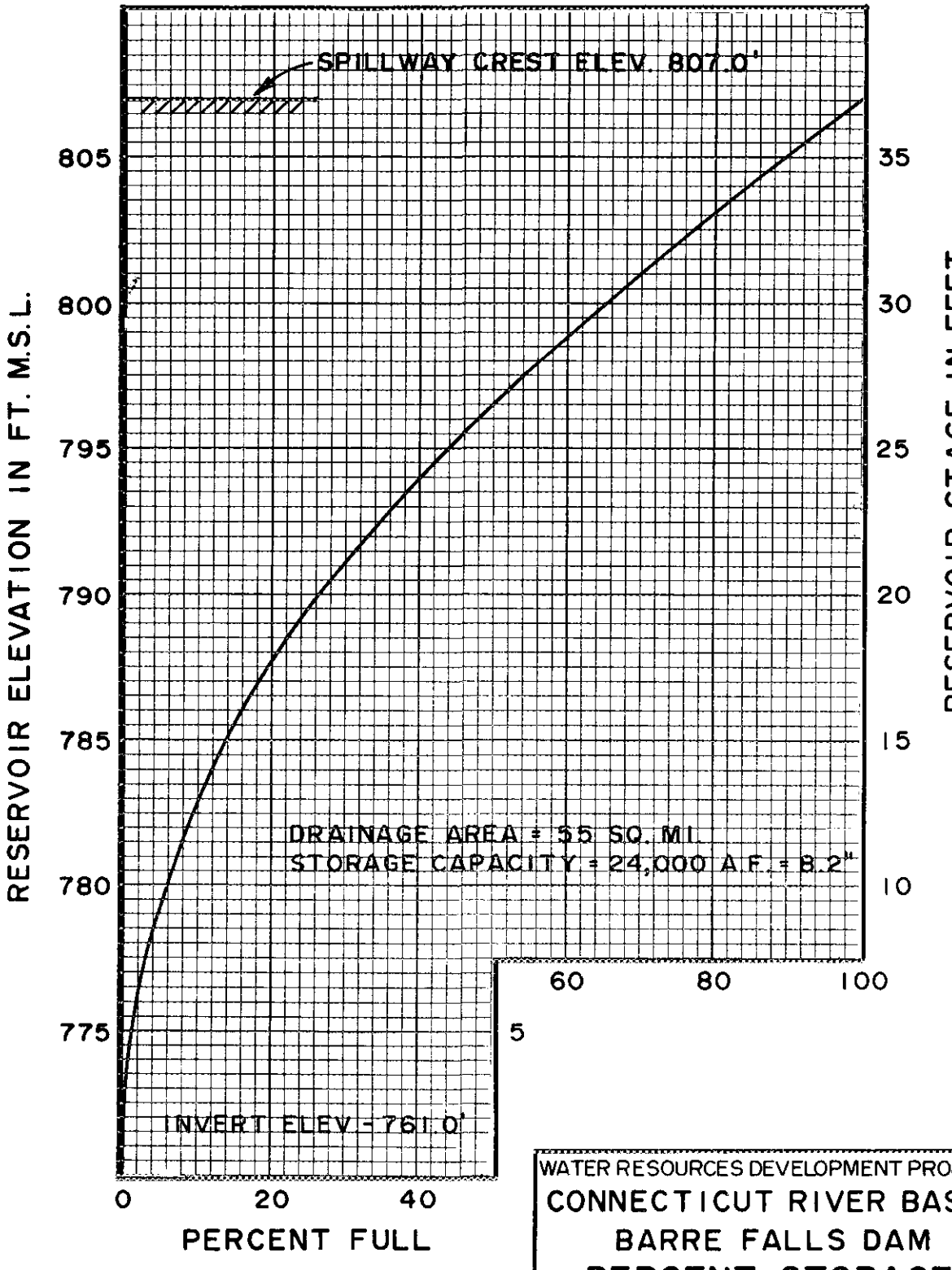
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
BARRE FALLS DAM
AREA-CAPACITY CURVES

NEW ENGLAND DIVISION, WALTHAM, MASS.

AUGUST 1978

PLATE G-37



NOTE: INVERT ELEV. = 761 DUE TO 9' DROP AT INLET CHANNEL.

WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
BARRE FALLS DAM
PERCENT STORAGE CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-38

CONANT BROOK DAM
AREA AND CAPACITY

DRAINAGE AREA = 7.8 SQ.MI.

Elev. (msl)	Stage (ft)	Area (acres)	Capacity Acre-Ft.	Capacity Inches
693	0	0	0	.00
694	1	1	1	.00
695	2	2	4	.01
696	3	3	8	.02
697	4	4	12	.03
698	5	5	16	.04
699	6	6	20	.05
700	7	8	24	.06
701	8	11	28	.07
702	9	15	40	.10
703	10	17	60	.14
704	11	19	80	.19
705	12	21	100	.24
706	13	23	125	.30
707	14	25	150	.36
708	15	27	180	.43
709	16	29	210	.50
710	17	31	240	.58
711	18	32	270	.65
712	19	34	310	.74
713	20	35	345	.83
714	21	36	380	.91
715	22	38	415	1.00
716	23	40	450	1.08
717	24	41	490	1.18
718	25	43	530	1.27
719	26	44	570	1.37
720	27	46	620	1.49
721	28	48	675	1.62
722	29	50	730	1.75
723	30	51	785	1.89
724	31	52	840	2.02
725	32	54	895	2.15
726	33	56	950	2.28
727	34	58	1010	2.43
728	35	60	1070	2.57
729	36	62	1130	2.72
730	37	64	1190	2.86
731	38	65	1250	3.00
732	39	66	1310	3.15
733	40	68	1375	3.30
734	41	69	1440	3.46
735	42	71	1505	3.62
736	43	73	1575	3.79
737	44	75	1650	3.97
738	45	77	1720	4.13
739	46	79	1800	4.32
740	47	80	1875	4.51
741	48	83	1950	4.59
742	49	85	2030	4.89
743	50	87	2110	5.07
744	51	89	2200	5.29
745	52	92	2300	5.53
746	53	94	2400	5.77
747	54	97	2500	6.01
748	55	100	2600	6.25
749	56	104	2705	6.50
750	57	107	2815	6.77
751	58	112	2940	7.07
752	59	119	3065	7.37
753	60	130	3190	7.67
754	61	139	3320	7.98
755	62	146	3450	8.29
756	63	152	3580	8.61
757	64	158	3740	9.00

Crest Elevation = 757

AREA OF RESERVOIR IN ACRES

240 220 200 180 160 140 120 100 80 60 40 20

158 AC.

3740 A.F.
90" R.O.

SPILLWAY CREST ELEV. - 757

INVERT ELEV. - 693

CAPACITY

AREA

1" 2" 3" 4" 5" 6" 7" 8" 9" 10" 11"

DRAINAGE AREA = 7.8 SQ. MI.
1" RUNOFF = 416 A.F.

POOL ELEVATION IN FEET ABOVE MSL

770 760 750 740 730 720 710 700 690

RESERVOIR STAGE IN FEET

67 57 47 37 27 17

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500

CAPACITY OF RESERVOIR IN ACRE FEET

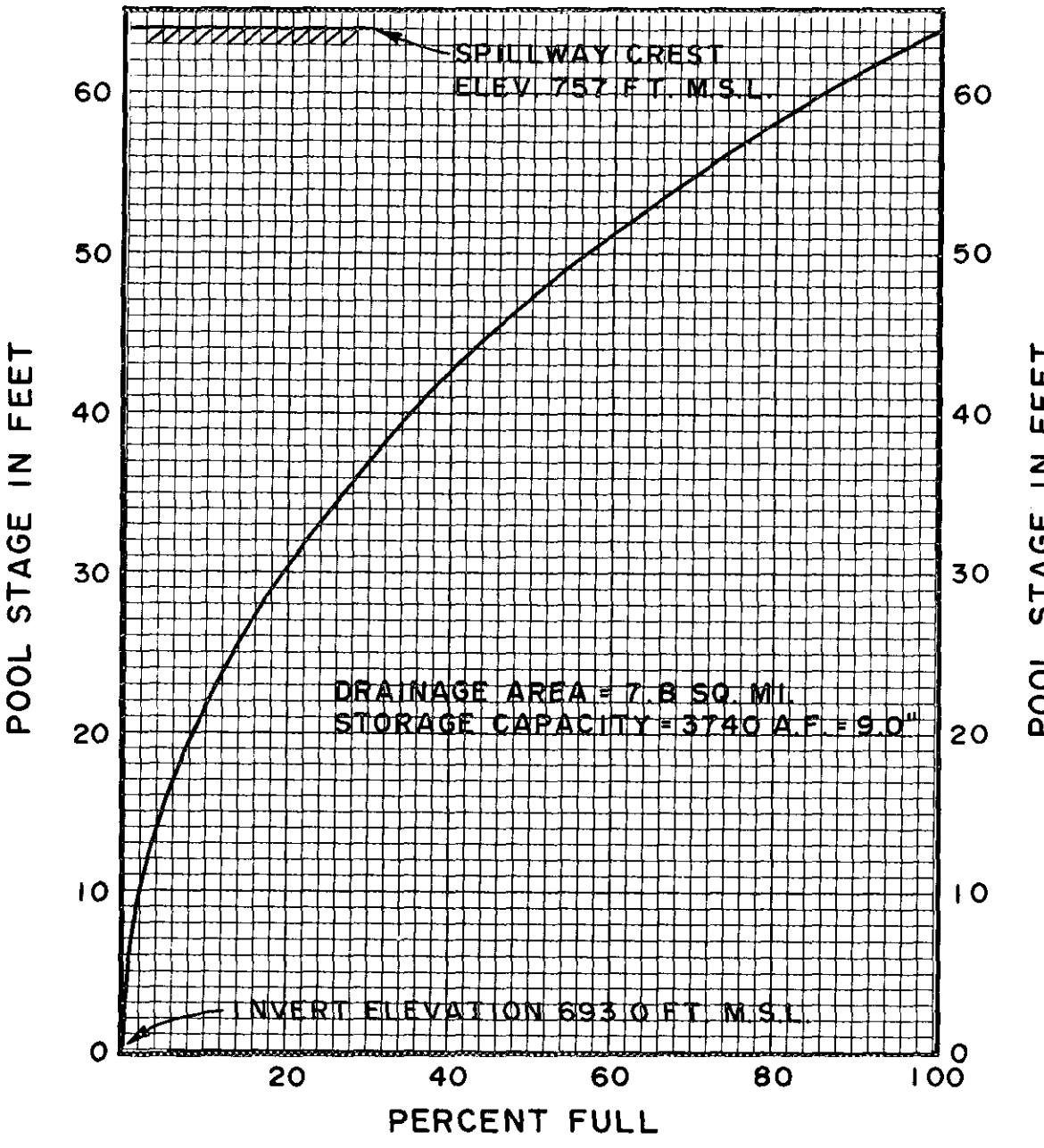
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
CONANT BROOK DAM
AREA-CAPACITY CURVES

NEW ENGLAND DIVISION, WALTHAM, MASS.

MAY 1978

PLATE G-40

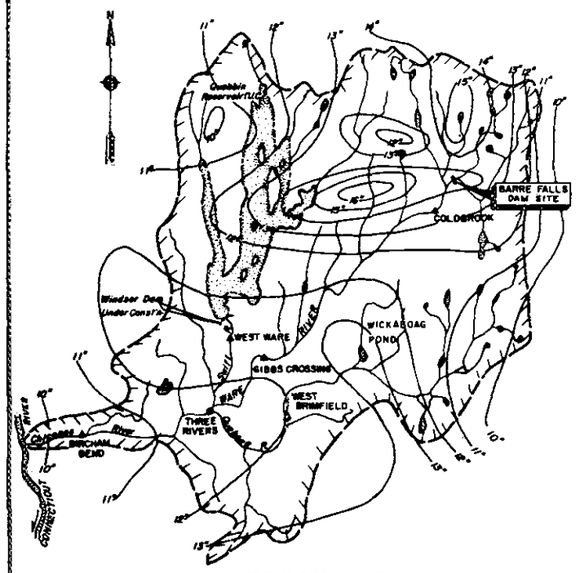


WATER RESOURCES DEVELOPMENT PROJECT

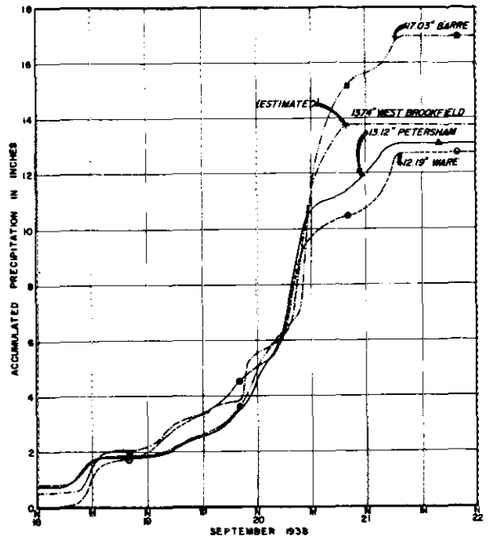
CONNECTICUT RIVER BASIN
CONANT BROOK DAM
PERCENT STORAGE CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

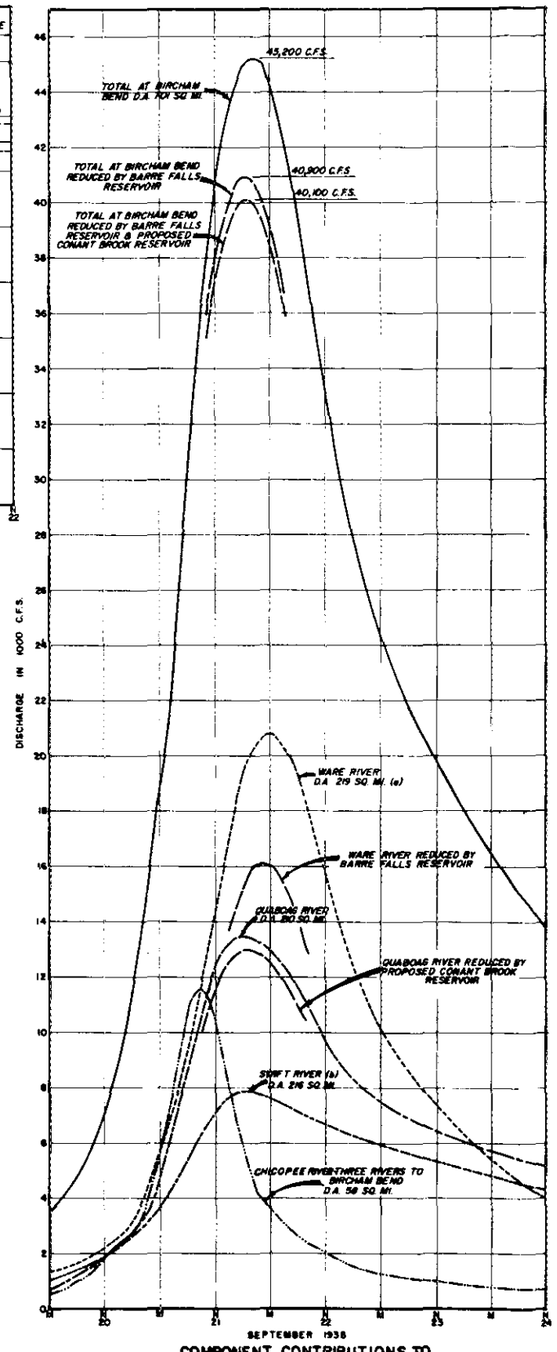
PLATE G-41



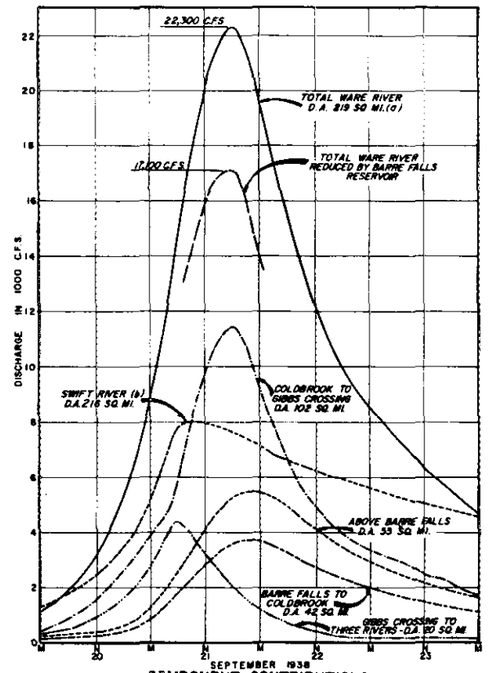
ISOHYETAL MAP
SEPTEMBER 17-22 1938 STORM
CHICOPEE RIVER BASIN
SCALE IN MILES



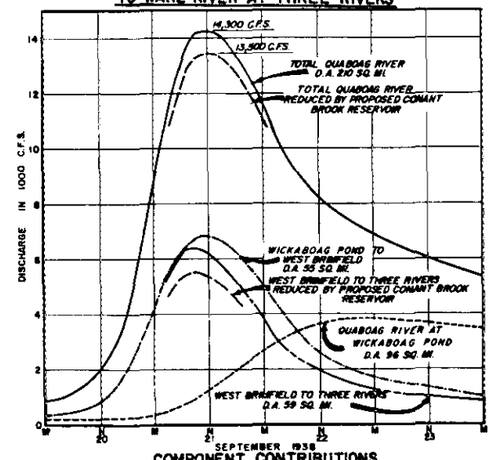
PRECIPITATION MASS CURVES



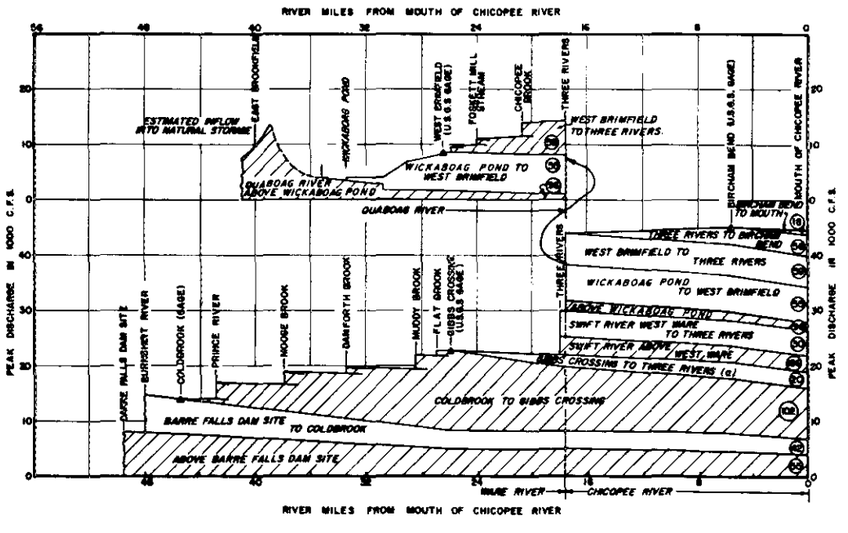
COMPONENT CONTRIBUTIONS TO CHICOPEE RIVER AT BIRCHAM BEND



COMPONENT CONTRIBUTIONS TO WARE RIVER AT THREE RIVERS



COMPONENT CONTRIBUTIONS TO QUABOAG RIVER AT THREE RIVERS



NATURAL PEAK DISCHARGE PROFILE AND TRIBUTARY CONTRIBUTIONS

NOTES

- U.S.G.S. Gaging Station
- (a) Denotes drainage area in Sq. Mi.
- (a) Exclusive of Swift River
- (b) Swift River affected by Quabbin Reservoir under construction at time of flood

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
	M.W.B	R. M.

SUBMITTED BY
CHIEF, FLOOD CONTROL SECTION
APPROVED
CHIEF ENGINEERS OFFICE
APPROVED
COL. U.S. ARMY DIVISION ENGINEER

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN

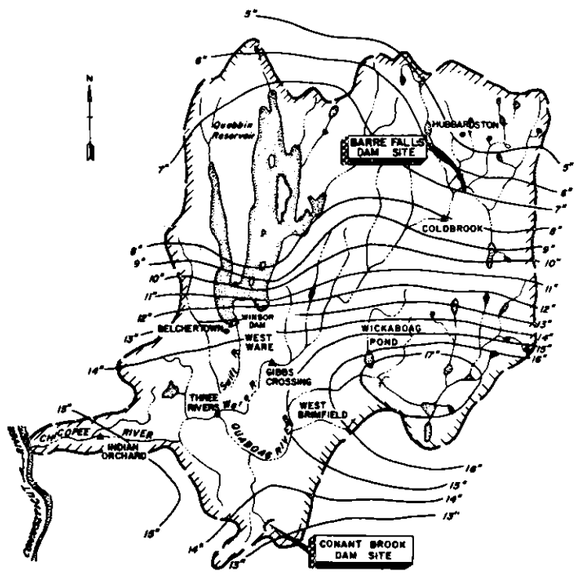
SEPTEMBER 1938 FLOOD

CHICOPEE RIVER, MASSACHUSETTS
DATE AUG. 1939

TO ACCOMPANY REPORT DATED: 8 SEPTEMBER 1939

SCALE AS SHOWN
DRAWING NUMBER
CT-1-5611
SHEET 1 OF 1

PLATE G-42

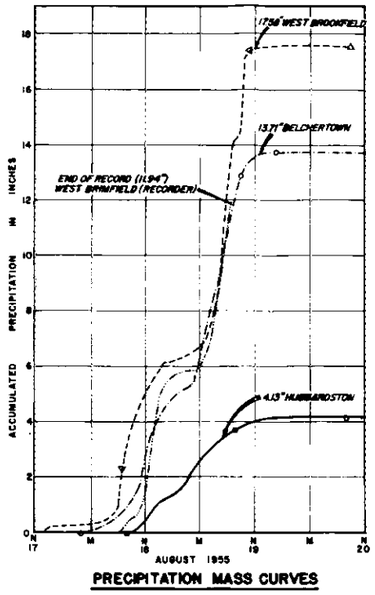


ISOHYETAL MAP

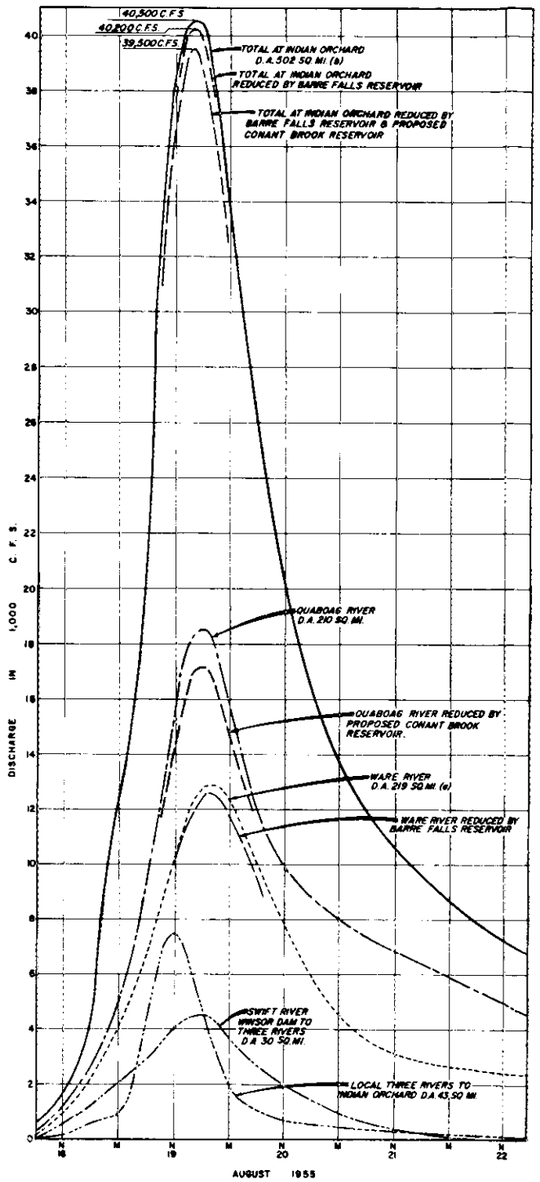
AUGUST 17-20 1955 STORM

CHICOPEE RIVER BASIN

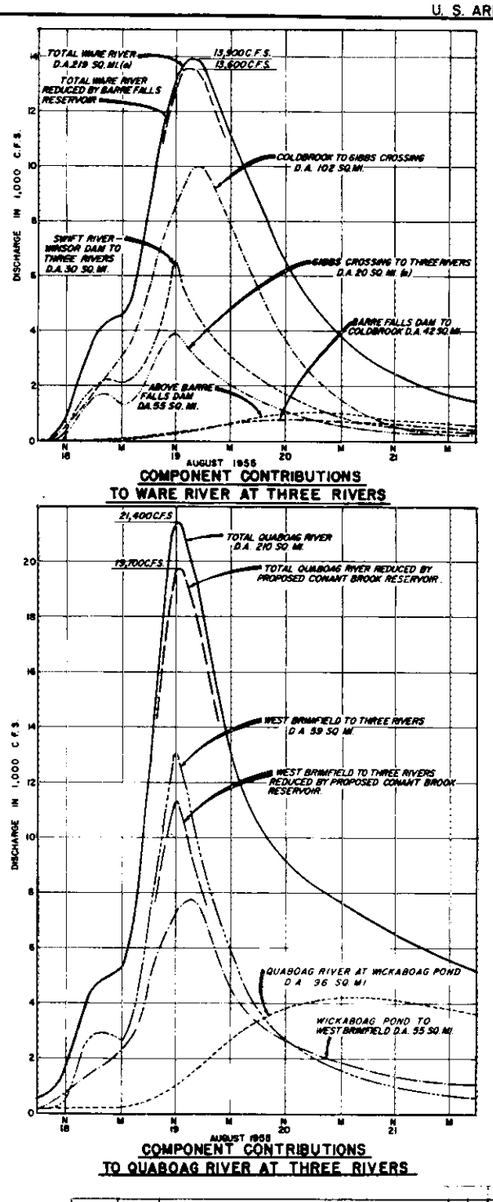
SCALE IN MILES



PRECIPITATION MASS CURVES

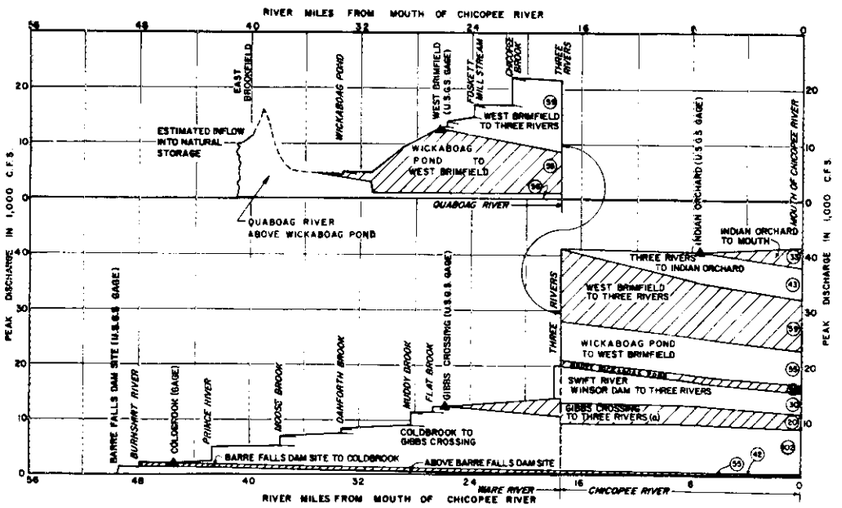


COMPONENT CONTRIBUTIONS TO CHICOPEE RIVER AT INDIAN ORCHARD



COMPONENT CONTRIBUTIONS TO WARE RIVER AT THREE RIVERS

COMPONENT CONTRIBUTIONS TO QUABOAG RIVER AT THREE RIVERS



NATURAL PEAK DISCHARGE PROFILE AND TRIBUTARY CONTRIBUTIONS

NOTES

▲ U.S.G.S. Gaging Station.

(55) Denotes drainage area in Sq. Mi. on profile

(a) Exclusive of Swift River.

(b) Exclusive of 186 Sq. Mi. on Swift River above Winsor Dam (Quabbin Reservoir)

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR BY	TR BY	CK BY
	M W B	R. M.

CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE RIVER BASIN

AUGUST 1955 FLOOD

CHICOPEE RIVER, MASSACHUSETTS

CHIEF, HYD. & HYD. SECTION — SUBMITTED BY

CHIEF, ENGINEERING DIV. — APPROVED

COL. C.E. COMMDG DIVISION ENGINEER — APPROVED — DATE AUG 1959

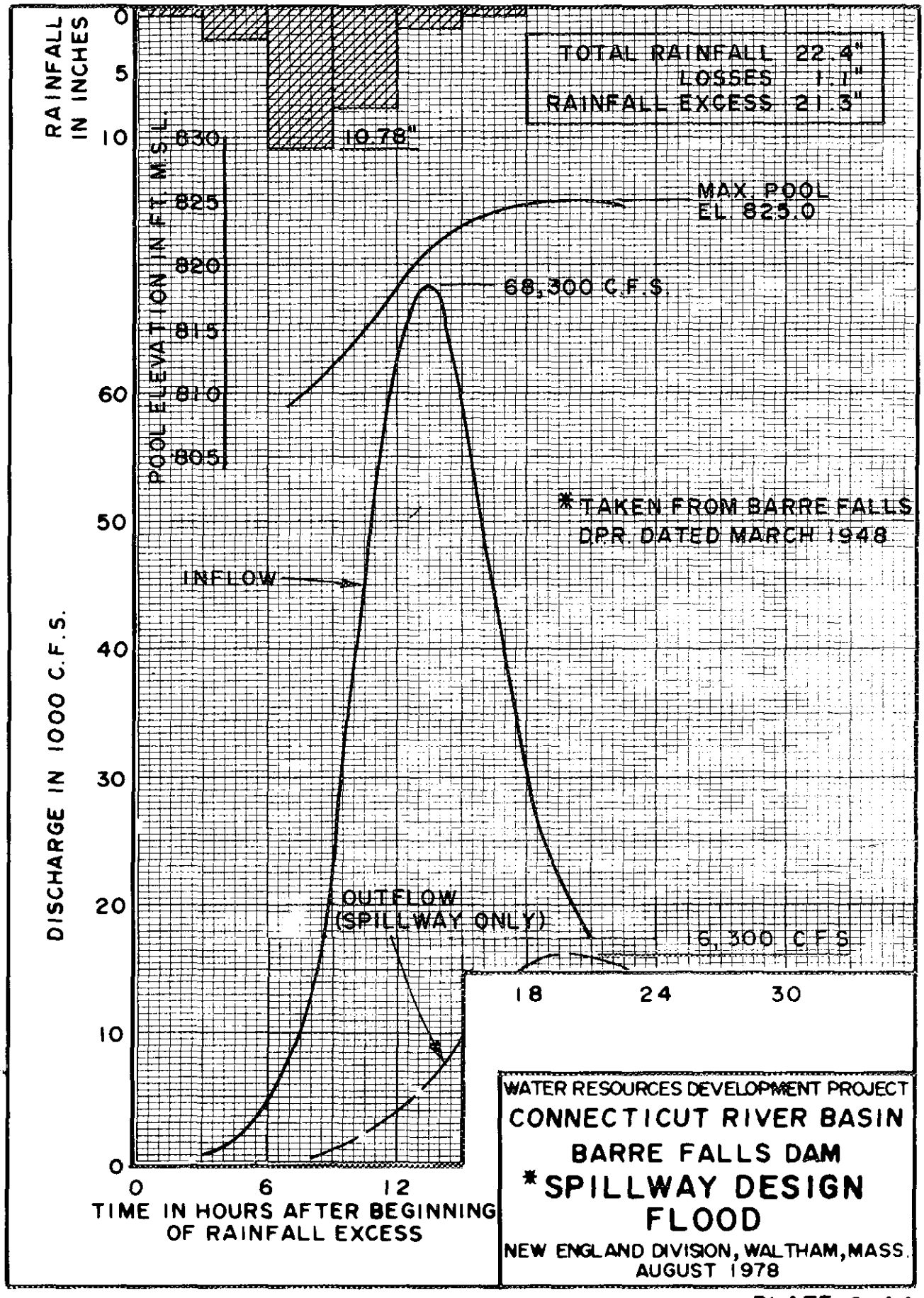
TO ACCOMPANY REPORT DATED 8 SEPTEMBER 1959

SCALE AS SHOWN

DRAWING NUMBER CT-1-5612

SHEET 1 OF 1

PLATE G-43



WATER RESOURCES DEVELOPMENT PROJECT

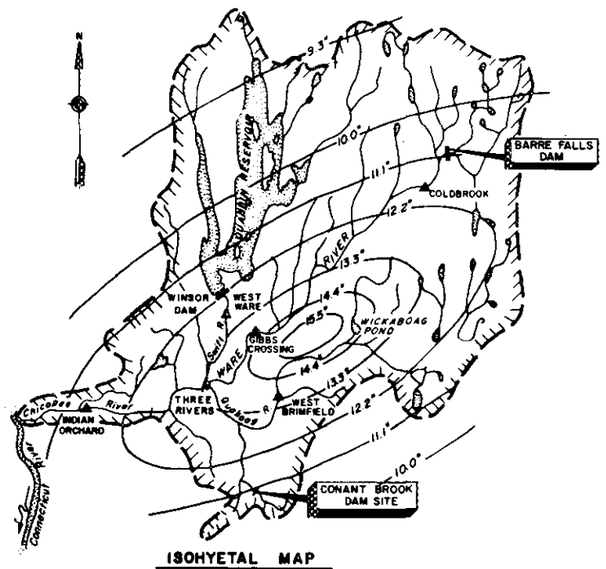
CONNECTICUT RIVER BASIN

BARRE FALLS DAM

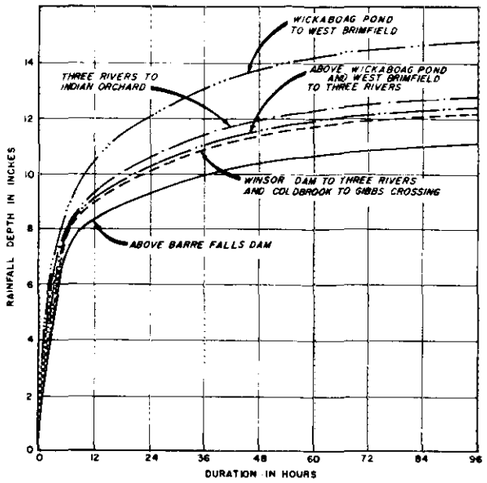
*SPILLWAY DESIGN FLOOD

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

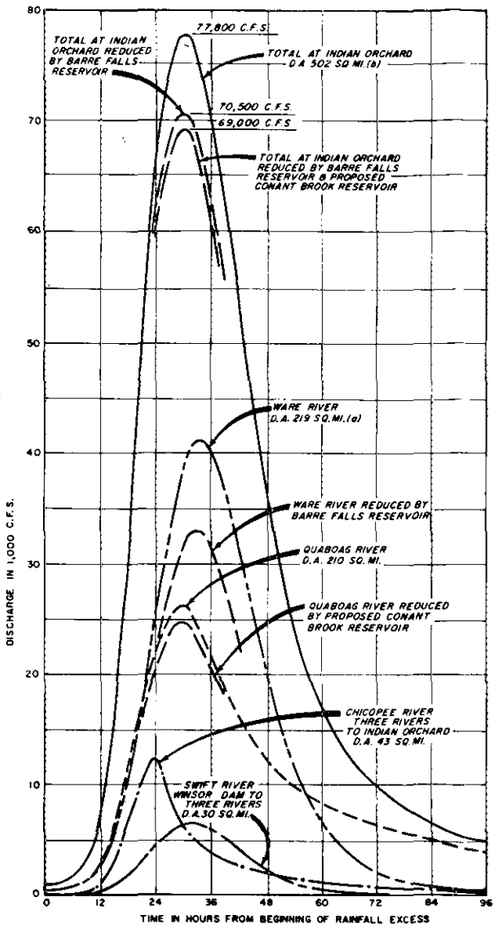
PLATE G-44



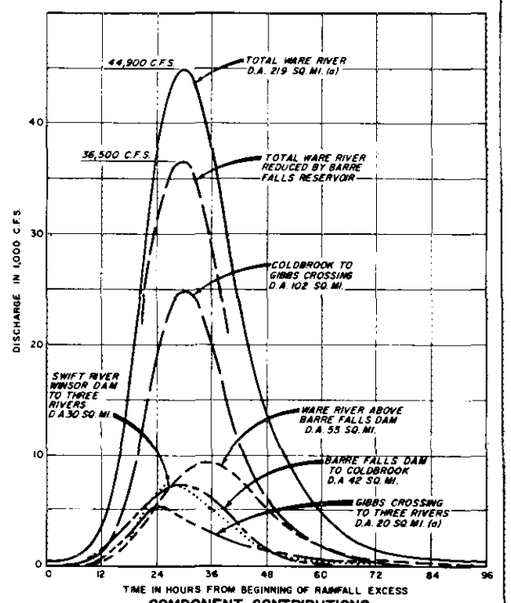
ISOHYETAL MAP
STANDARD PROJECT STORM
96-HOUR DURATION



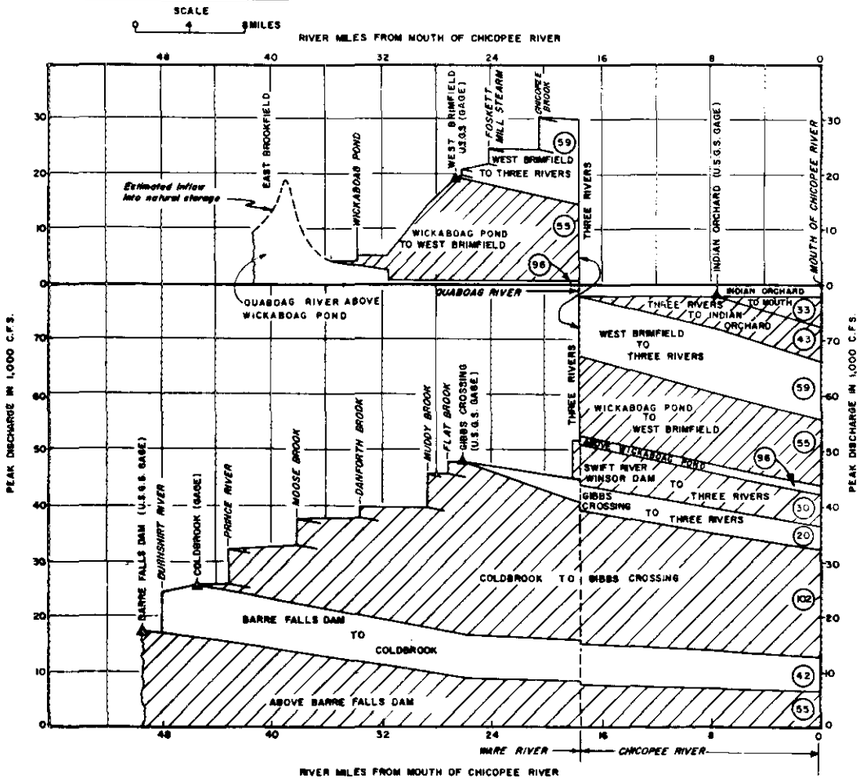
DEPTH DURATION CURVES



COMPONENT CONTRIBUTIONS
TO CHICOPEE RIVER AT INDIAN ORCHARD



COMPONENT CONTRIBUTIONS
TO WARE RIVER AT THREE RIVERS



NATURAL PEAK DISCHARGE PROFILE AND TRIBUTARY CONTRIBUTIONS

NOTES:
(55) Denotes drainage area in sq. mi. on profile
(a) Exclusive of Swift River
(b) Exclusive of 186 sq. mi on Swift River above Winsor Dam (Quabbin Reservoir)
▲ USGS Gaging Station

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR BY	TR BY	CH. BY
	S.J.C.	H.M.

CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE RIVER BASIN
STANDARD PROJECT FLOOD
CHICOPEE RIVER, MASSACHUSETTS

CHIEF, HYD & HYD SECTION
CHIEF ENGINEERING DIV
COL C.E. ASSIST'T DIVISION ENGINEER
DATE AUG 1939

TO ACCOMPANY REPORT
DATED: 8 SEPTEMBER 1939

SCALE AS SHOWN
DRAWING NUMBER
CT-1-5616
SHEET 1 OF 1

PLATE G-46

ALL STATION SCAN 2 FEB. 1973

COASTAL STATION	FILE NO.	DAY HR.MIN.	TIDE	BAROMETER	WIND VELOCITY	WIND DIRECTION
40 BLOCK ISLAND	54	33 2055	2.80 FT.	29.03 IN. WARN	49 MPH	225 DEGR
COASTAL STATION	FILE NO.	DAY HR.MIN.	TIDE	BAROMETER	WIND VELOCITY	WIND DIRECTION
41 OLD SAYBROOK	52	33 2055	2.50 FT.	29.12 IN. WARN	39 MPH	149 DEGR

STA. NO. AND NAME	FILE NO.	DAY HR.MIN.	DISCH.	CFS/SM	STAGE		CHNGSTG	RAIN	INCR.
98									
38 WELLS RIVER	72	33 2055	7024.	2.7	4.60 FT.		0.0		
36 WEST HARTFORD	72	33 2056	840.	1.2	4.30 FT.		−0.1		
35 WHITE RIVER JUNCTION	69	33 2056	11590.	2.8	8.70 FT.		−0.1		
37 N WALPOLE	72	33 2056	14850.	2.7	10.90 FT.		0.0		
15 KEENE	72	33 2056	0.	0.0	69.50 FT.		0.4		
7 WEST DEERFIELD	73	33 2056	3234.	5.8	4.30 FT.		0.2		
6 MONTAGUE CITY	73	33 2056	21340.	2.7	14.10 FT.		0.8		
17 INDIAN ORCHARD	72	33 2056	1500.	2.2	6.10 FT.		0.0		
18 WESTFIELD	72	33 2056	1824.	3.7	6.10 FT.		−1.4		
16 SPRINGFIELD	72	33 2056	19600.	2.0	5.60 FT.		0.2		
27 MAD RIVER DAM	63	33 2057				NO REPORT			
24 COLLINSVILLE	72	33 2057	9000.	25.4	12.20 FT.	FSTG	5.7		
20 RAINBOW	72	33 2057	2210.	3.7	3.40 FT.		0.0		
19 HARTFORD	70	33 2057	20600.	2.0	7.20 FT.		0.4		
34 RUMNEY	71	33 2057	387.	2.7	3.50 FT.		0.1	15.67 IN.	0.36 WARN
33 WOODSTOCK	72	33 2057	3946.	20.4	6.70 FT.	WARN	1.4	4.03 IN.	0.37 WARN
39 CAMPTON	70	33 2057	422.	7.3	10.80 FT.		0.3	2.65 IN.	0.17
32 PLYMOUTH	72	33 2057	3450.	5.5	3.00 FT.	CHRG	0.1		
10 PENACOOK	73	33 2057	3520.	4.6	4.00 FT.		0.0		
3 SOUCOOK	69	33 2057	214.	2.8	6.80 FT.		0.1		
11 CONCORD	73	33 2058	6190.	2.6	5.30 FT.		0.1		
8 GOFFSTOWN	72	33 2058	782.	7.5	5.70 FT.		1.1		
9 GOFFS FALLS	73	33 2058	6832.	2.2	5.60 FT.		−0.1		
14 LOWELL	73	33 2058	27499.	5.9	48.20 FT.		0.1		
96									
28 HALL MEADOW DAM	72	33 2058	132.	7.7	7.40 FT.		2.0		
30 EAST BRANCH DAM	71	33 2058	119.	13.0	17.30 FT.		6.7	5.80 IN.	0.22
26 THOMASTON DAM	72	33 2058	996.	10.2	26.80 FT.		11.9		
31 NORTHFIELD BRK. LAKE	72	33 2058	89.	15.7	28.60 FT.		9.7		
25 BLACK ROCK LAKE	72	33 2058	345.	15.2	39.10 FT.		9.1		
23 HANCOCK BROOK LAKE	72	33 2058	190.	15.9	8.60 FT.		0.8		
29 HOP BROOK LAKE	72	33 2059	288.	17.6	27.80 FT.		4.9		
22 BEACON FALLS	73	33 2059	6832.	26.2	9.20 FT.	FSTG	0.8		
21 STEVENSON	72	33 2059	15400.	10.0	11.60 FT.	WARN	2.5		
99									
13 NORTHBRIDGE	73	33 2059	−0.	0.0	−10.00 FT.	NVLD1			
12 WOONSOCKET	73	33 2059	2658.	6.4	5.30 FT.		0.9		
2 WEBSTER	73	33 2059	574.	6.7	6.60 FT.	WARN	0.2		
4 JEWETT CITY	73	33 2059	4290.	6.0	10.20 FT.		0.2		
1 WILLIMANTIC NATCH.P.	73	33 2059	3602.	9.0	7.10 FT.	WARN	1.2	14.06 IN.	0.55 WARN

LOG OF RADIO REPORTS – FLOOD CONTROL DAMS

15 July 1977

WACHUSETT RELAY

Line	ITEM	66 WEST HILL	54 LITTLE-VILLE	53 KNIGHT-VILLE	51 BIRCH HILL	50 TULLY	52 BARRE FALLS	65 MANS-FIELD HOLLOW	62 EAST BRIM-FIELD	63 WEST-VILLE	64 WEST THOMP-SON	61 HODGES VILLAGE	60 BUFFUM-VILLE	BUZZARDS BAY 24 NEW BEDFORD BARRIER	Line
1	Time of Observation	0800	0800	0800	0800	0800	0800	0800	0800	0800	0800	0800	0800		1
2	Precipitation(last 24 hrs.)	0	0	0	-	-	0	0	0	0	0	0	0		2
3	Form of Precipitation	-	-	-	-	-	-	-	-	-	-	-	-		3
4	Present Weather	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear		4
5	Pool Stage	2.18	518.83	2.4	1.825	15.0	777.97	17.15	13.29	10.57	15.66	3.02	11.02		5
6	Tendency	Steady	Falling	Falling	Steady	Rising	Steady	Steady	Rising	Steady	Steady	Rising	Steady		6
7	Gate Openings	3-0-3	3-3	3-3-3	4-4-4-4	0-.15	3-3	F-.1-0-0-0	2-2-.1	0-F-.1	.1-1-0	3-3	.1-F-F		7
8	Tailwater Gage	1.37	2.00	2.87	4.15	2.76	2.37	2.1160	2.83	3.67	2.64	1.13	15		8
9	Outflow	9	60	189	89	17	8	155	43	65	118	19			9
10	INDEX POINTS	4.1	OUT		4.3		3.54	3.1				4.65			10
11		526	4.3				94	541				36			11
12		1.64	580												12
13		263													13
14															14
15															15

REMARKS

1 1/2" Alert

NED FORM OCT 75 477(A)

PLATE G-48

NED FORM APR 65 503

REGULATION OF RESERVOIRS AND LOG OF REPORTS AND INSTRUCTIONS

RCS NEDED-3

DATE AND TIME OF REPORT	Barre Falls RES. RES POOL		GATE OPENING								OUTFLOW		RES. RES POOL		GATE OPENING			OUTFLOW		PRECIPITATION				Ware RIVER AT Barre Plains			Chicopee RIVER AT Indian Orchard			RIVER AT			RIVER AT		
	HOUR	STAGE	1	2	3	4	5	6	7	8	T.W.	C.F.S	HOUR	STAGE	1	2	3	TW.	C.F.S.	LOCATION	HOUR	INCHES INC	INCHES ACC.	HOUR	STAGE	C.F.S	HOUR	STAGE	C.F.S	HOUR	STAGE	C.F.S	HOUR	STAGE	C.F.S
1977																																			
13Mar	1715	776.2	1.5	1.5							3.98	280								Barre Falls	1715	1.25	1.25	1715	3.4		1715	9.12	4888						
14Mar	0815	779.8	1.5	1.5							4.25	375								Barre Falls	0815	0.5	1.75	0815	3.5		0815	9.22	5028						
	GO	TO	.5	.5																															
	1300	781.7	.5	.5							3.47	135												1300	3.4		1300	9.11	4874						
	GO	TO	1	1																															
	1500	782.3	1	1							3.97	275								Barre Falls	1500	0.15	1.90	1500	3.4		1500	9.07	4818						
15Mar	0800	785.6	1	1							4.07	310								Barre Falls	0800	0.35	2.25	0800	3.3		0800	8.97	4681						
	GO	TO	2	2																															
	1500	786.2	2	2							4.77	625												1500	3.0		1500	8.71	4343						
	GO	TO	3	3																															
16Mar	0800	786.0	3	3							5.23	915												0800	2.8		0800	7.86	3282						
17Mar	0800	785.2	3	3							5.22	890								Barre Falls	0800	0.15	2.40	0800	2.7		0800	7.34	2704						
18Mar	0800	783.7	3	3							5.15	860												0800	2.5		0800	6.96	2270						
	1500	782.9	3	3							5.08	813								Barre Falls	0800	0.08	2.48	1500	2.4		1500	6.80	2150						

END OF OPERATION

PLATE G-49

NED FORM 102
15 Nov. 1951

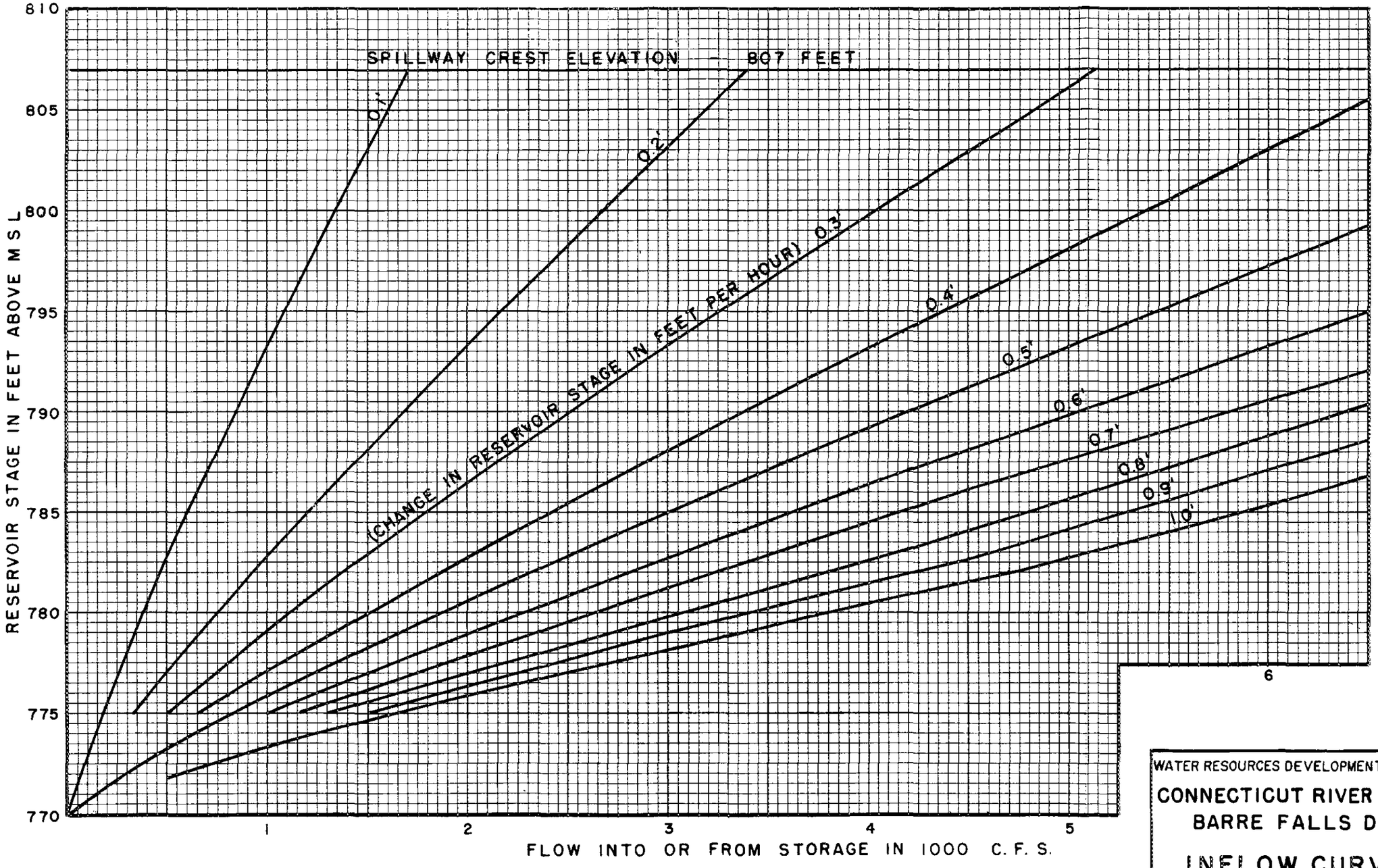
RESERVOIR REGULATION
COMPUTATION OF INFLOW

Flood of APRIL 1960

Reservoir BARRE FALLS DAM By _____ Date APRIL 1960

TIME	RES. STAGE Feet	CHANGE IN RES. STAGE Feet per hour		FLOW into/from STORAGE c.f.s.	OUTFLOW c.f.s.	TOTAL INFLOW (5) + (6) c.f.s.	REMARKS
		Observed	Adjusted				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
31 Mar							
0800	777.39				221		
		0.46	0.23	600		821	
1000	777.85				90		
		0.79	0.39	1100		1190	
1200	778.64				90		
		0.56	0.28	950		1040	
1400	779.20				90		
		0.50	0.25	850		940	
1600	779.70				95		
		0.50	0.25	900		995	
1800	780.20				95		
		0.60	0.30	1000		1095	
2000	780.80				95		
		0.50	0.25	1050		1145	
2200	781.30				95		
		0.50	0.25	1080		1175	
2400	781.80				95		
1 April		0.50	0.25	1130		1225	
0200	782.30				95		
		0.50	0.25	1200		1295	
0400	782.80				95		
		0.50	0.25	1250		1345	
0600	783.30				95		
		0.46	0.23	1200		1295	
0800	783.76				100		
		0.47	0.23	1250		1350	
1000	784.23				100		
		0.46	0.23	1330		1430	
1200	784.69				125		
		0.42	0.21	1400		1525	
1400	785.11				150		

PLATE G-50



BOTTOM OF RESERVOIR - ELEV. 770 FT.
INVERT - ELEV. 761 FT.

NOTE: INVERT ELEVATION = 761 DUE TO 9-FOOT DROP AT INLET CHANNEL.

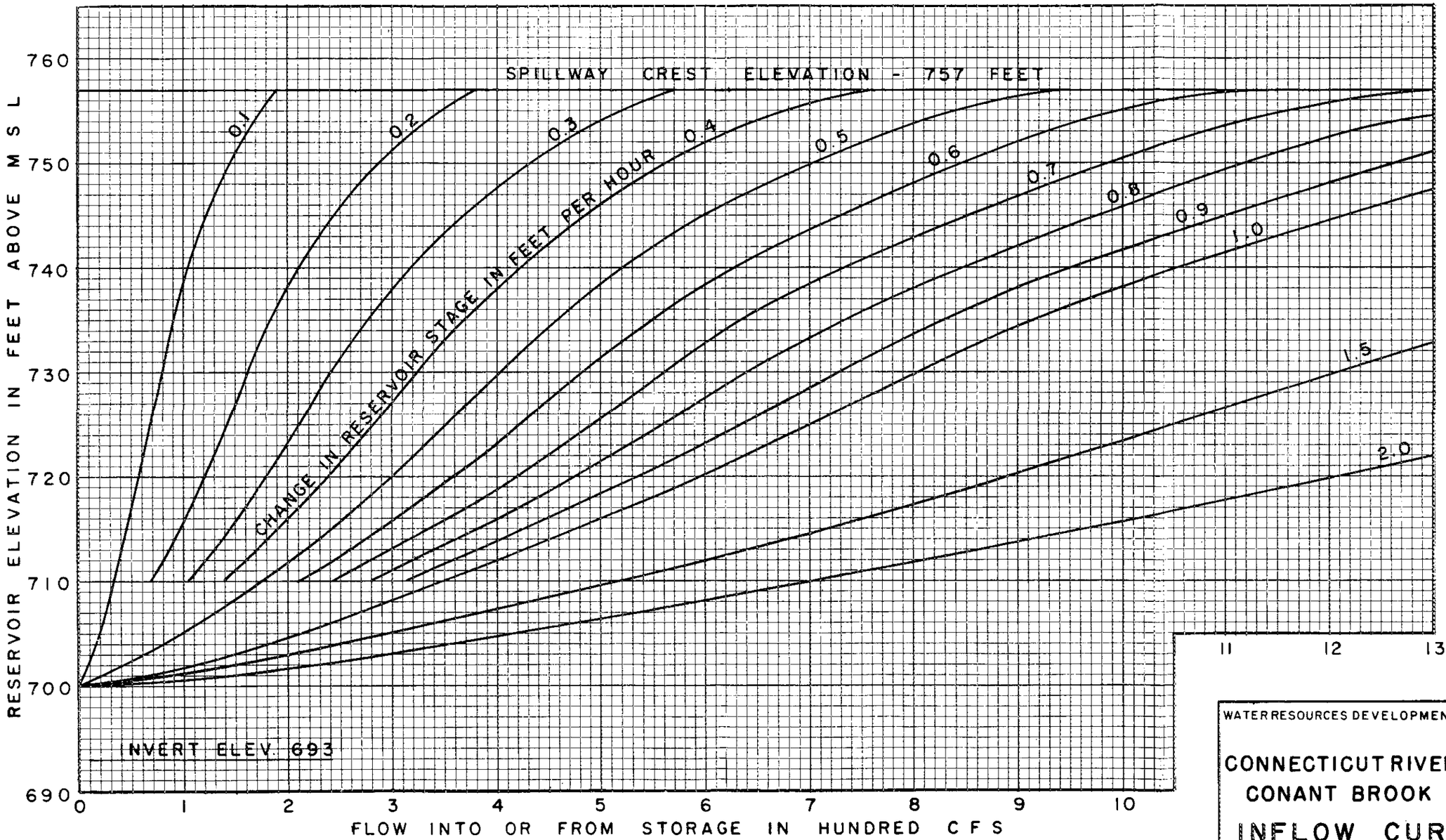
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
BARRE FALLS DAM

INFLOW CURVES

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-51



WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
CONANT BROOK DAM
INFLOW CURVES

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-52

GATE OPERATION RECORD

Barre Falls RESERVOIR March MONTH 77 YEAR

OPERATOR

L.D.	DAY	HOUR	RES. STAGE	OUTFLOW	PRECIP.	T. W.	GATE SETTING 1 2 3 4 5 6 7 8	REMARKS
	13	0800	774.83	264	.	393	1.5 1.5	
	14	0800	779.80	317	1.75	4.09	1.5 1.5	Gate Change
	14	1300	781.70	135	.	3.47	.5 .5	Gate Change
	14	1500	782.30	236	.	3.84	1 1	
	15	0800	785.60	251	.	3.89	1 1	Gate Change
	15	1500	786.20	485	.	4.50	2 2	Gate Change
	16	0800	786.20	629	.	4.78	3 3	
	17	0800	785.20	624	.	4.77	3 3	
	18	0800	783.70	570	.	4.67	3 3	Gate Change
	18	1500	782.90	815	.	5.09	4 4	
	19	0800	780.18	730	.35	4.96	4 4	
	20	0800	772.76	331	.	4.13	4 4	
	21	0800	772.55	267	.	3.94	4 4	Gate Change
	22	0800	772.50	215	.	3.87	2 2	

NED FORM SEP 70 90 REPLACES EDITION OF MAR 62 WHICH IS OBSOLETE

PLATE G-53

STANDARD OPERATING PROCEDURE (SOP)
FLOOD CONTROL REGULATION
BARRE FALLS DAM

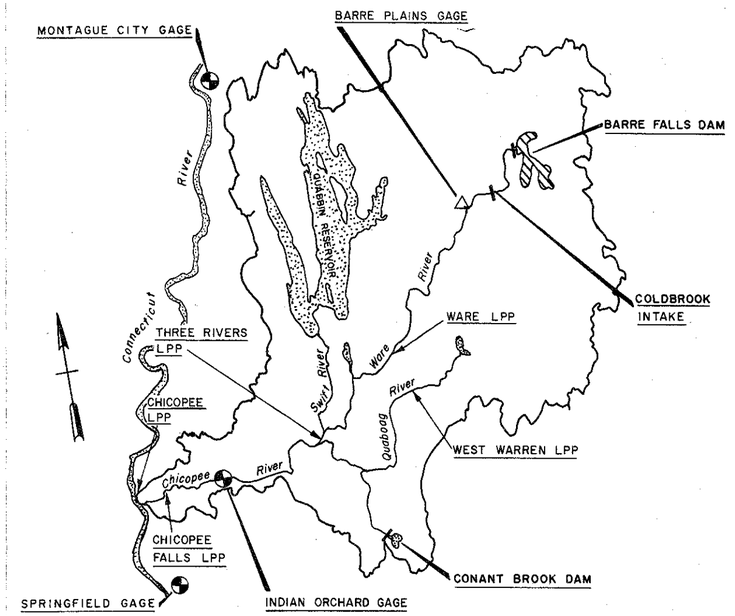
PHASE	STORM RAINFALL (WITHIN 24-HR. PERIOD) ANTECEDENT CONDITIONS		BARRE FALLS DAM	RIVER INDEX STATIONS (STAGE IN FEET)					REGULATION INSTRUCTIONS	DUTIES DURING EACH PHASE
				WARE RIVER AT		CHICOPEE RIVER AT	CONNECTICUT RIVER AT			
	SNOW-COV'R'D WET OR FROZEN GROUND	DRY GROUND	RISING POOL STAGE FEET	COLD-BROOK (MDC INTAKE) (97 SQ. MI.)	BARRE PLAINS (RTE 32 HWY BRIDGE) (115 SQ. MI.)	INDIAN ORCHARD (USGS GAGE) (688 SQ. MI.)	MONTAGUE CITY (USGS GAGE) (7,855 SQ.MI.)	SPRING-FIELD (NWS) (9,587 SQ.MI.)	GATE SETTINGS BARRE FALLS DAM	
I - APPRAISAL			SUMMER WINTER							FLOOD CONTROL PROJECT MANAGER
FIRST ALERT	1.0"	1.0"	776' MSL 780' MSL	—	—	—			2'-2'	PHASE I 1. COLLECT AND TRANSMIT RAINFALL AND STAGE DATA TO RCC. 2. OPERATE ACCORDING TO INSTRUCTIONS FROM RCC.
SECOND ALERT	1.5" (Or As Instructed)	2.0"	As Instructed	—	—	—				PHASE II 1. OPERATE ACCORDING TO INSTRUCTIONS FROM RCC. 2. NOTE ALL UNUSUAL CONDITIONS AT DAM, DOWNSTREAM CHANNELS AND INDEX STATIONS. 3. COLLECT AND TRANSMIT RAINFALL AND STAGE DATA AT MINIMUM 3-HOUR INTERVALS OR AS DIRECTED BY RCC.
INITIAL REGULATION	2.0" (Or As Instructed)	3.0"	As Instructed	—	GROWING SEASON 1.5 NON-GROWING 3.5	8.0 (3450 CFS)			BOTH GATES CLOSED TO 1-FOOT GATE SETTINGS	PHASE III 1. CONTINUE PHASE II, STEP 3. 2. RECONNOITER DOWNSTREAM CHANNELS AND POTENTIAL DAMAGE AREAS. 3. REPORT TO RCC FOR FURTHER INSTRUCTIONS.
II - CONTINUATION OF REGULATION	3.0" (Or As Instructed)	4.0"	As Instructed	—	GROWING SEASON 2.0 NON-GROWING 4.0	10.0 (6160 CFS)	26 (68,800 CFS)	18 (126000 CFS)	RESTRICT OUTFLOW TO MINIMUM RELEASES (0.1'-0)	
III - EMPTYING THE RESERVOIRS	STORM HAS ABATED		NONDAMAGING DOWNSTREAM CHANNEL CAPACITY FOR BARRE FALLS IS 1000± CFS DURING NON-GROWING SEASON, 600± CFS DURING GROWING SEASON							PROJECT REGULATOR PHASE I 1. COMPILE DATA. 2. PLAN AND COORDINATE NEXT TRANSMISSION TO PROJECT MANAGERS. 3. RESTRICT OUTFLOW TO MAINTAIN SAFE DOWNSTREAM CHANNEL CAPACITIES. 4. INFORM CONNECTICUT RIVER BASIN REGULATOR OF ACTIONS. PHASE II 1. CONTINUE REGULATION INSTRUCTIONS TO PROJECT MANAGERS. 2. CONSULT WITH BASIN REGULATOR TO ANALYZE SEVERITY OF FLOOD. 3. COORDINATE REGULATION WITH CONNECTICUT RIVER BASIN REGULATOR. PHASE III 1. COLLECT DATA FROM PROJECT MANAGERS. 2. CONSULT WITH CONNECTICUT RIVER BASIN REGULATOR. 3. TRANSMIT INSTRUCTIONS TO PROJECT MANAGERS.

EMERGENCY OPERATION PROCEDURE (EOP)
(During Communications Failure with RCC)

	Partial Closure 1' - 1'	Complete Closure 0 - 0.1'
Rainfall in 24 hour Period	2.0"	3.0"
Rising Stages		
Barre Plains	1.5'	2.0'
Indian Orchard	8.0'	9.0'

Notes:

1. Emptying the reservoir shall not be initiated until contact has been established with RCC.
2. The rate of discharge shall not exceed 150 cfs/hour up to 600 cfs and 50 cfs/hour over 600 cfs.
3. Maximum rate of reservoir drawdown at Barre Falls should not exceed 5 feet/24 hours.
4. Refer to Paragraph 26 for regulation at Barre Falls while Coldbrook Diversion is operating.
5. Reservoir roads should be barricaded when a rising pool is expected to exceed 783.5 ft. MSL.
6. Following is a list of legal diversion criteria at the Coldbrook Diversion:
   a. No Diversion is allowed between 15 June and 15 October.
   b. All flows in excess of 132 cfs from 15 Oct. to 1 Dec. with permission of the Mass. Dept. of Public Health.
   c. All flows in excess of 132 cfs from 1 December to 31 May.
   d. All flows in excess of 132 cfs from 31 May to 15 June with permission of the Mass. Dept. of Public Health.



LEGEND

- USGS GAGE
- △ STAFF GAGE

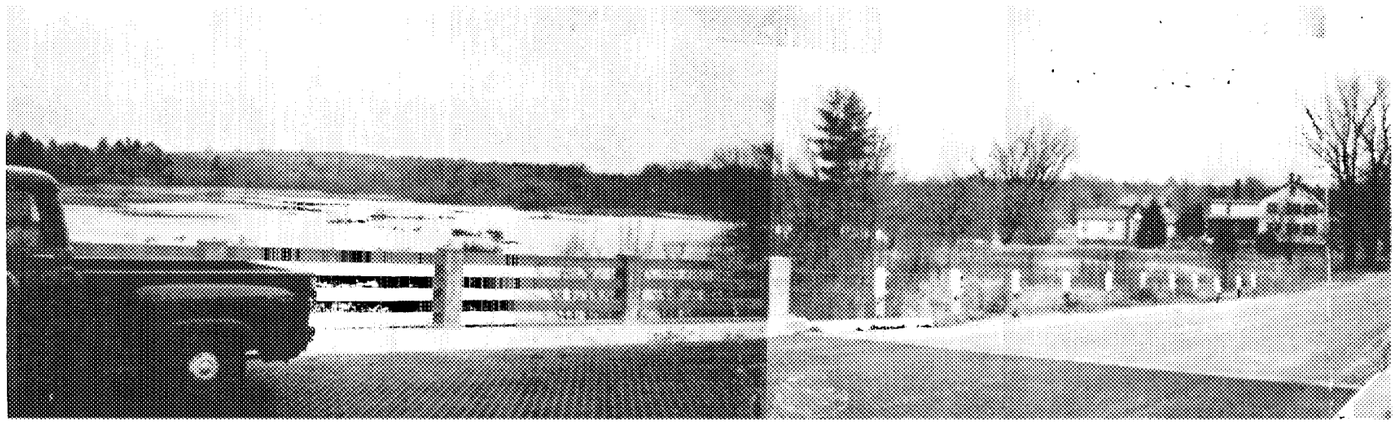
SCALE IN MILES 1 0 1 2 3

AVERAGE PEAK TRAVEL TIME

BARRE FALLS DAM TO COLDBROOK INTAKE	3 - 4 HOURS
BARRE FALLS DAM TO BARRE PLAINS	5 - 7 HOURS
BARRE FALLS DAM TO THREE RIVERS	18 - 20 HOURS
BARRE FALLS DAM TO THE MOUTH OF THE CHICOPEE	22 - 26 HOURS

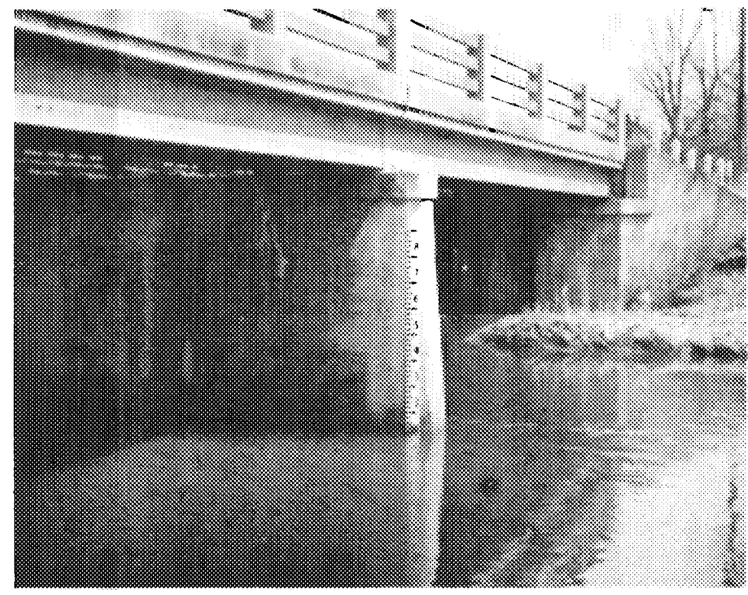
PLATE G-54

WARE RIVER AT BARRE PLAINS

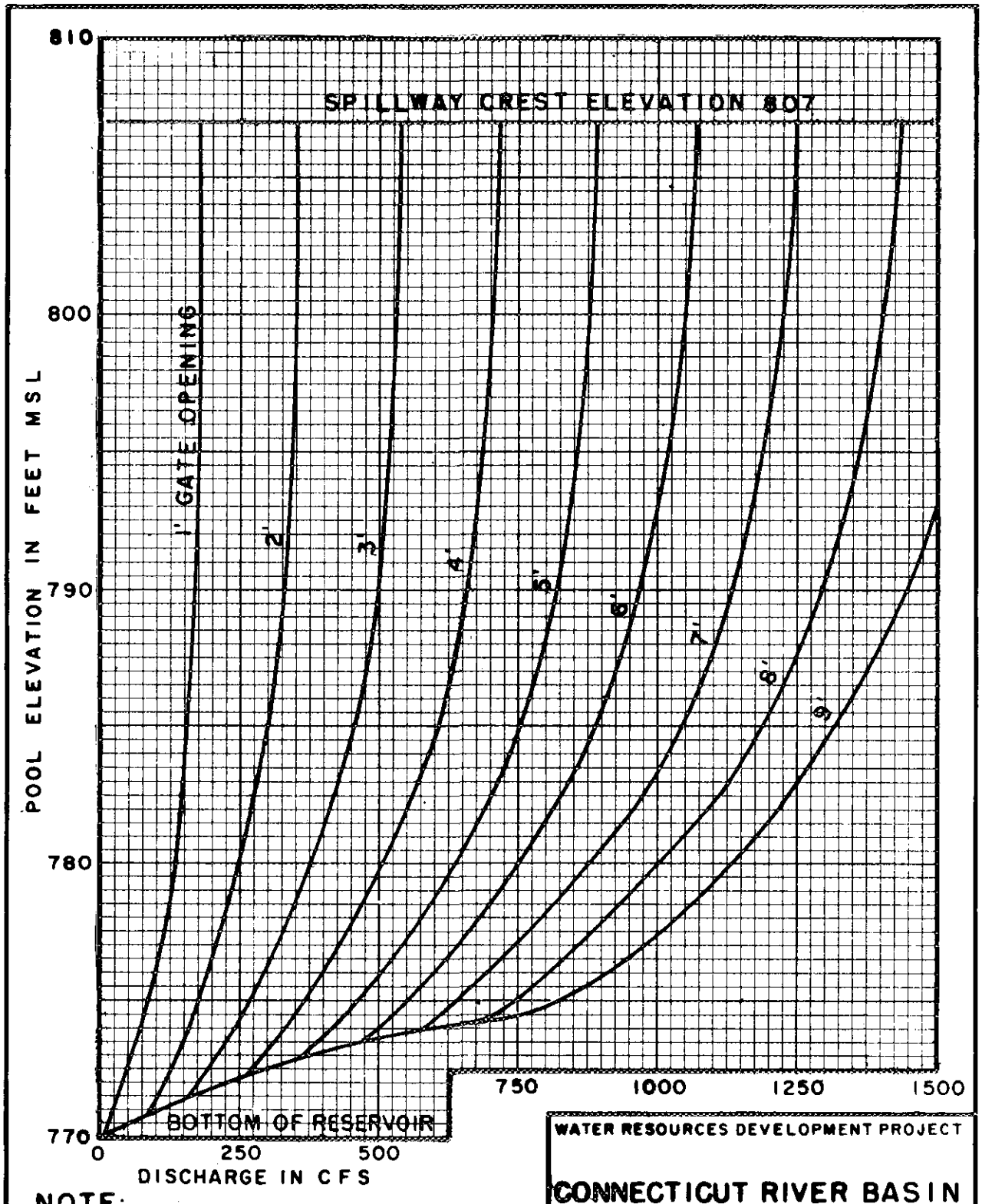


LOOKING UPSTREAM

LOOKING DOWNSTREAM BARRE PLAINS (RT. 32 BRIDGE)



WARE RIVER AT BARRE PLAINS
STAFF GAGE



NOTE:

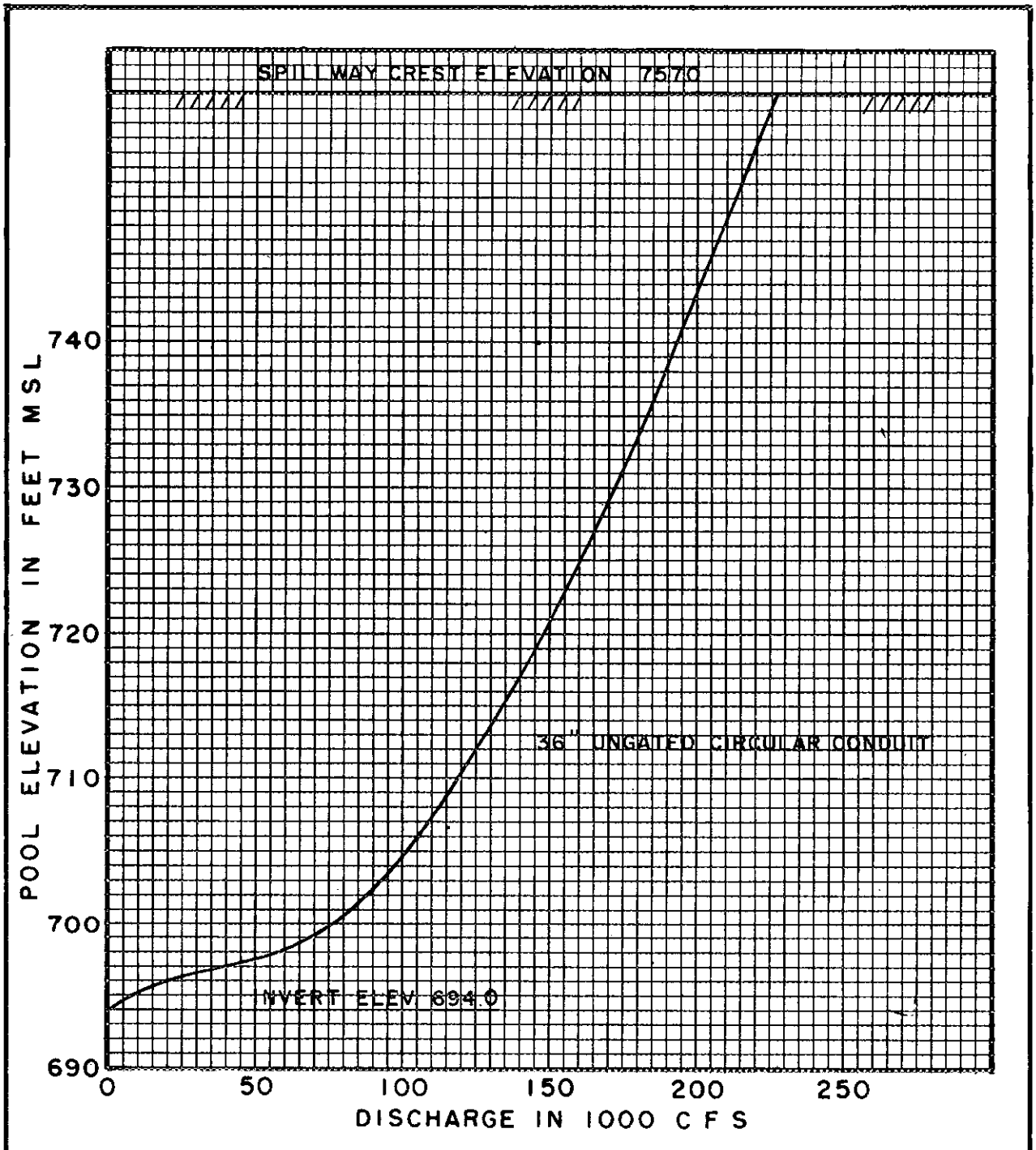
TWO FLOOD CONTROL GATES EACH 4.5 FEET WIDE x 9 FEET HIGH.

WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
BARRE FALLS DAM
OUTLET RATING CURVE FOR ONE GATE

NEW ENGLAND DIVISION, WALTHAM, MASS.
SEPTEMBER 1978

PLATE G-56



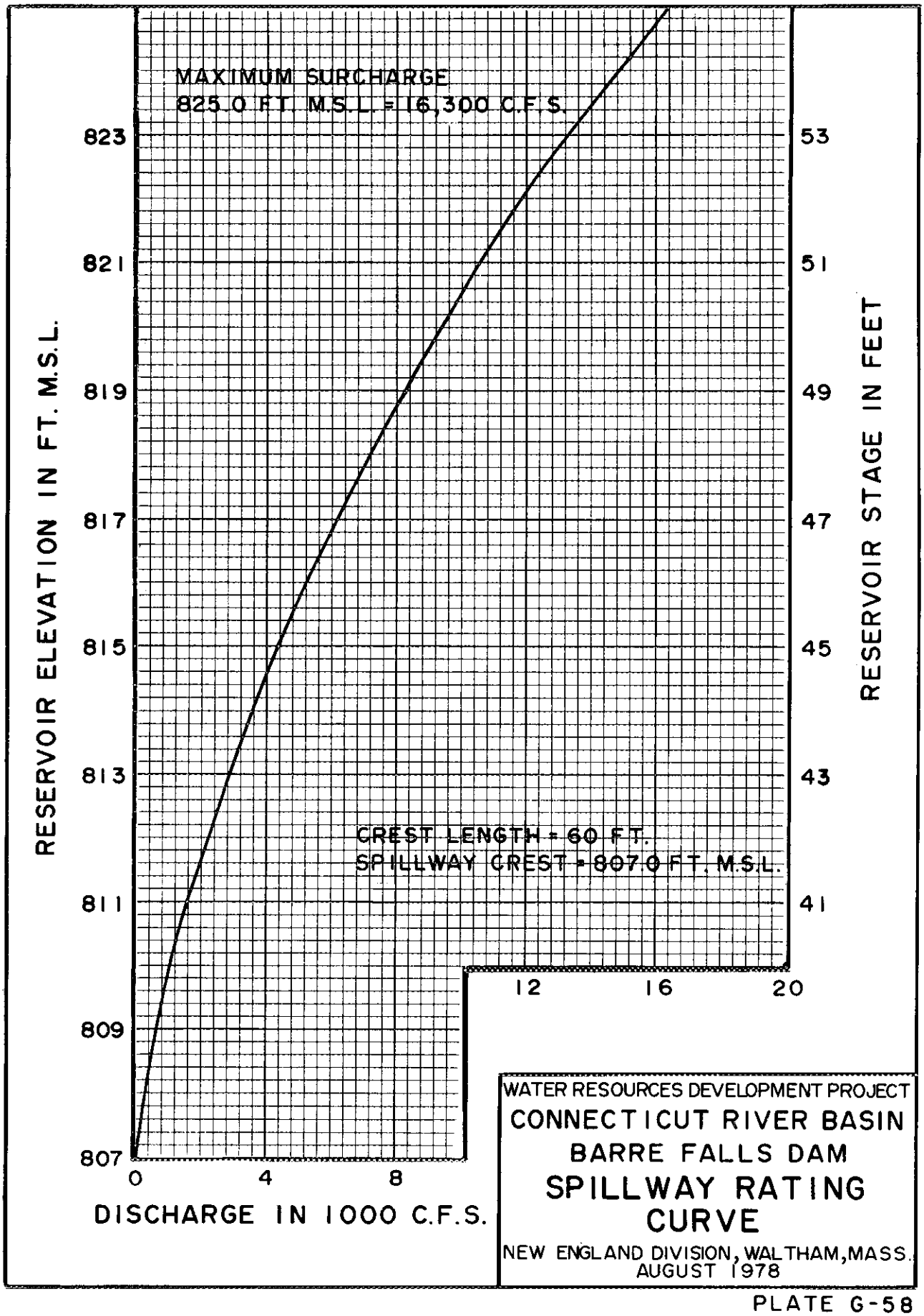
WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
CONANT BROOK DAM

OUTLET RATING CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
SEPT. 1978

PLATE G-57



WATER RESOURCES DEVELOPMENT PROJECT

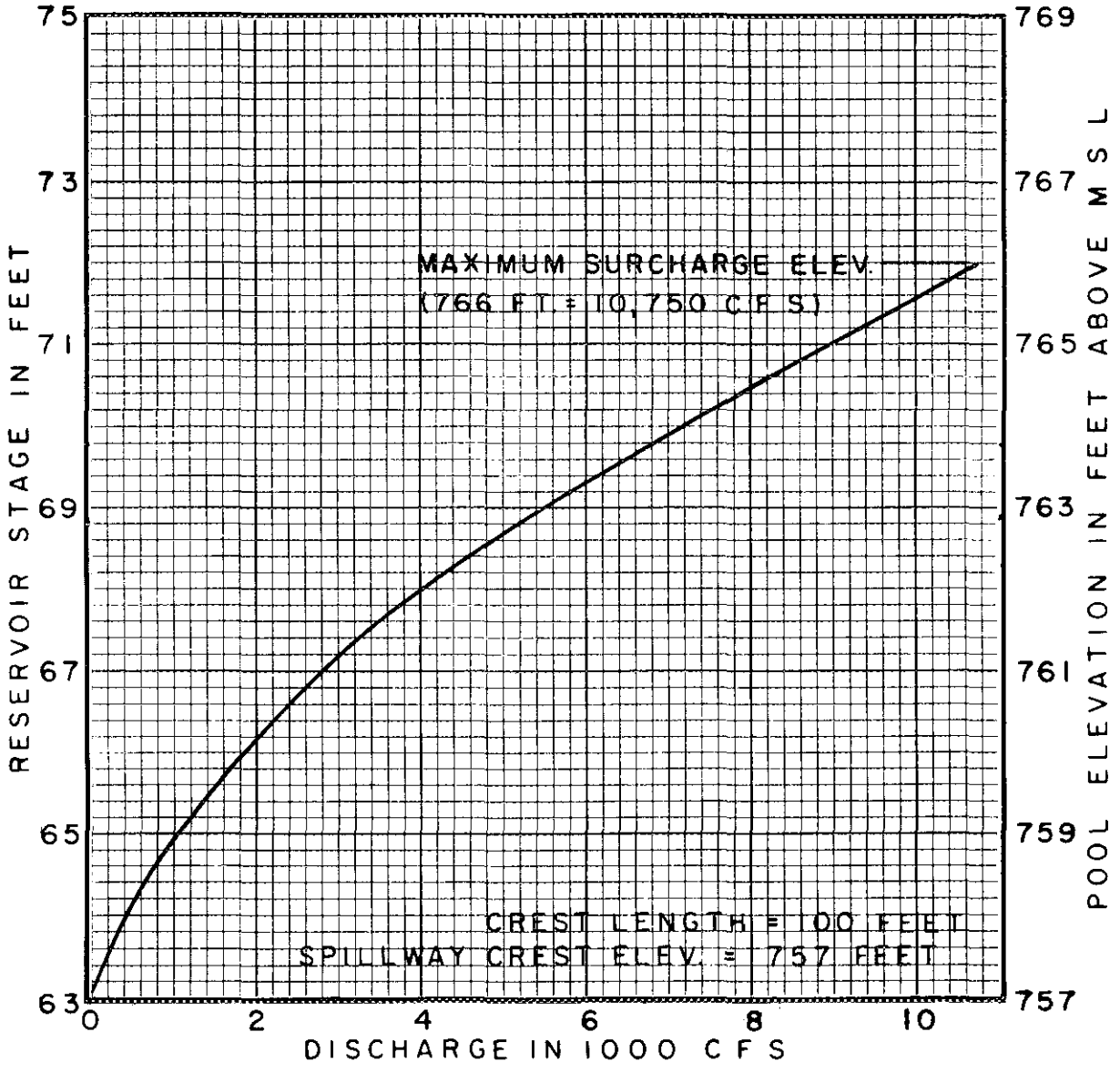
CONNECTICUT RIVER BASIN

BARRE FALLS DAM

SPILLWAY RATING CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1978

PLATE G-58

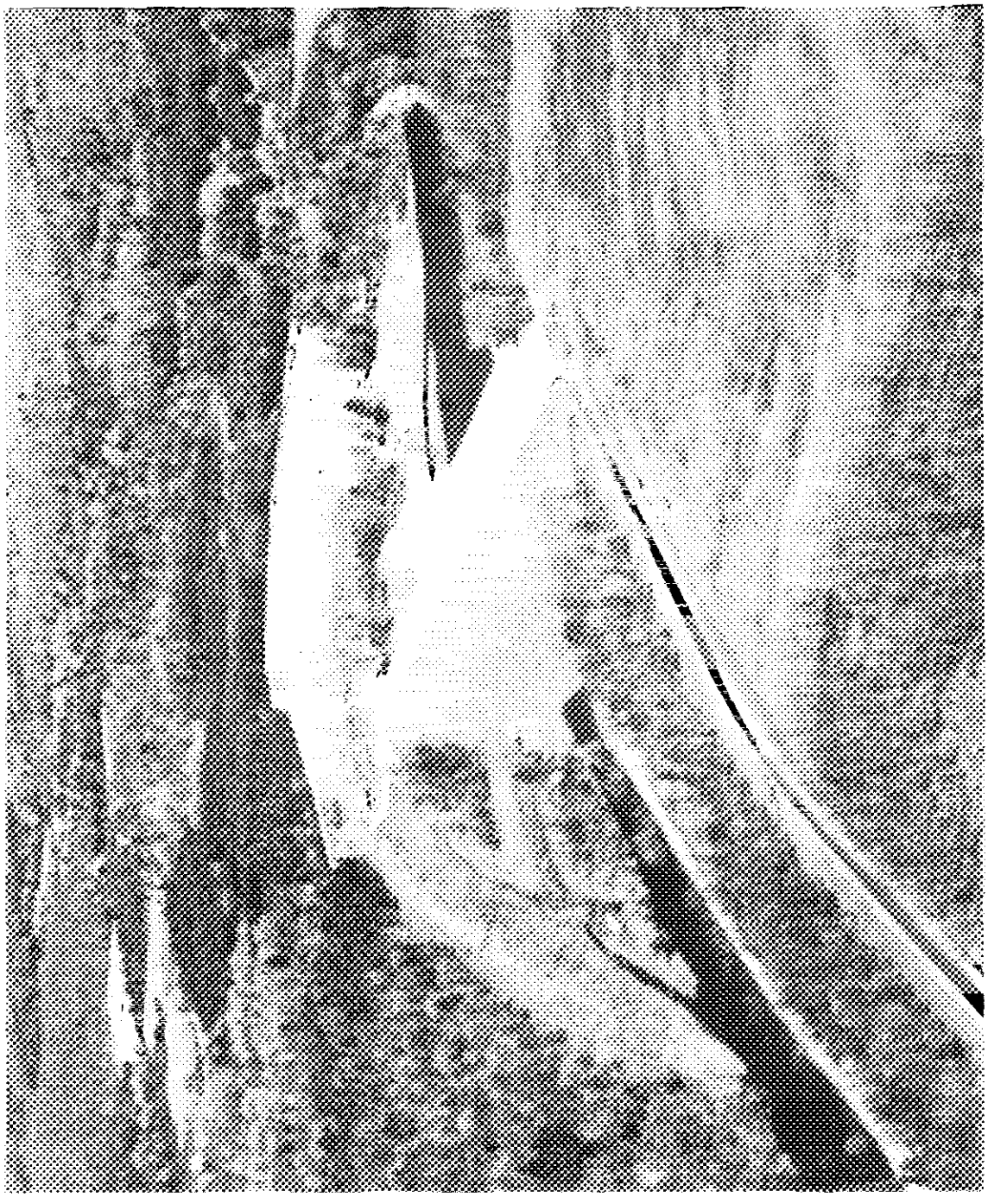


WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN
CONANT BROOK DAM
SPILLWAY RATING CURVE

NEW ENGLAND DIVISION, WALTHAM, MASS.
MAY 1978

PLATE G-59



VIEW OF CONANT BROOK DAM

PLATE G-61